PROCEEDINGS

OF

THE CHEMICAL SOCIETY.

Vol. XIX. Nos. 259—273.
JANUARY—DECEMBER, 1903.

LONDON
GURNEY & JACKSON, 10, PATERNOSTER ROW.
1904.

RICHARD CLAY AND SONS, LIMITED,
BREAD ST. HILL, E.C., AND
BUNGAY, SUFFOLK.

LIST OF GRANTS MADE FROM THE RESEARCH FUND DURING THE YEAR.

£5 to J. B. Cohen, to continue the study of bromo- and chloro-toluenes and their derivatives.

£5 to J. McCrae, to investigate the optical activity of derivatives of active *sec.*-butylamine.

£10 to J. J. Sudborough, to continue his research on steric hindrance; and derivatives of trinitrobenzene.

£15 to R. S. Morrell and J. M. Crofts, to continue their investigation of the action of hydrogen peroxide on carbohydrates in the presence of ferrous sulphate.

£25 to J. N. Collie, to investigate the production of mixed tertiary phosphines and phosphonium bases; and the preparation of condensation products from the sodium derivative of diacetylacetone.

£12 to T. S. Patterson, to continue his research on the optical activity of compounds in solution.

£15 to A. Lapworth, to investigate some $\alpha\beta$-unsaturated ketones, acids, and allied substances.

£10 to A. W. Harvey, to investigate some asymmetric substituted ammonium compounds.

£25 to F. Soddy, to investigate the spectrum of radium emanation, and the nature of the α projected particle, and the ultimate products of the disintegration of radium.

£10 to J. Wade, to continue his investigation of the cyanogen compounds as bearing on the mechanism of the interchange of radicles.

£5 to H. A. Auden, to investigate the experiments on heterocyclic ring syntheses.

£10 to J. C. Cain, to continue his research on the action of water on *o*-substituted diazonium salts.

£10 to F. G. Donnan, to investigate the reaction between the alkyl iodides and silver nitrate in alcoholic solution.

£10 to G. D. Lander, to investigate the imino-ethers and allied compounds.

£10 to B. Prentice, to investigate the constitution of 1 : 5-pyrazolidone compounds.

£10 to A. Slator, to investigate the reactions between sodium thiosulphate and organic chlorides, bromides, and iodides.

£10 to S. Smiles, to investigate the optical activity of some sulphur compounds.

£25 to B. D. Steele, to investigate the conductivity of solutions of substances in liquefied gases.

£10 to J. J. Sudborough, to investigate the esterification constants of organic acids.

LIST OF FELLOWS ELECTED DURING 1903.

Name.	Proposed.	Elected.
Abell, Robert Duncombe	November 5th, 1903	December 3rd.
Adshead, Henry Guest	March 5th, 1903	April 22nd.
Alderton, Gilbert John	November 19th, 1902.	February 18th.
Alton, William Lester St. John	March 18th, 1903	April 22nd.
Appleyard, George Henry	January 21st, 1903	February 18th.
Appleyard, Percy	November 5th, 1903	December 3rd.
Armstrong, Edward Frankland	,, ,,	,, ,,
Ashdown, Herbert Henry	,, ,,	,, ,,
Atkinson, Edwin Bayles	December 17th, 1902.	February 18th.
Atkinson, Harford Montgomery	March 5th, 1903	April 22nd.
Attwell, Herbert Moore	November 5th, 1903	December 3rd.
Aubrey, Henry James	April 22nd, 1903	June 17th.
Badcock, William Cornish	November 5th, 1903	December 3rd.
Bailey, Harold James	,, ,,	,, ,,
Barger, George	April 22nd, 1903	June 17th.
Barker, Thomas Vipond	November 5th, 1903	December 3rd.
Bayly, Harold Goodenough	,, ,,	,, ,,
Beadnell, Charles Marsh	,, ,,	,, ,,
Beam, William	,, ,,	,, ,,
Bennett, Colin Noel	May 20th, 1903	June 17th.
Beveridge, Wilfrid William Ogilvy	June 4th, 1903	,, ,,
Bhaduri, K.	December 17th, 1902.	February 18th.
Bibby, Charles Drake	April 22nd, 1903	June 17th.
Bibby, R. Gordon	February 18th, 1903.	April 22nd.
Blackshaw, George Neville	March 5th, 1903	,, ,,
Bliss, Henry James Wheeler	November 5th, 1903.	December 3rd.
Bluman, Nicholas John	,, ,,	,, ,,
Bowen, William	December 17th, 1902.	February 18th.
Bradbury, Samuel	January 21st, 1903	,, ,,
Branch, George Thomas	,, ,,	,, ,,
Brennand, Henry John Wolverton	April 22nd, 1903	June 17th.
Brühl, Paul	November 5th, 1903.	December 3rd.
Buggé, Erasmus Robert	,, ,,	,, ,,
Burghard, William Godsell	April 2nd, 1903	June 17th.
Bury, Ernest	May 7th, 1903	,, ,,
Bywaters, Hubert William	January 21st, 1903	February 18th.
Cadman, William Henry	January 21st, 1903	February 18th.
Calvert, Harry Thornton	March 5th, 1903	April 22nd.
Campbell, Thomas	May 7th, 1903	June 17th.
Carrier, Albert James	,, ,,	,, ,,
Castell-Evans, John	January 21st, 1903	February 18th.
Caudwell, Ben	March, 5th, 1903	April 22nd.
Clacher, William	November 5th, 1903.	December 3rd.
Codling, Arthur John	January 21st, 1903	February 18th.
Cousins, Francis George	December 4th, 1902.	,, ,,
Coyle, Benjamin Claxton	January 21st, 1903	,, ,,

Name.	Proposed.	Elected.
Deeks, William Thomas	November 5th, 1903.	December 3rd.
Derwent, Ernest	June 4th, 1903	,, ,,
Desch, Cecil Henry	January 21st, 1903	February 18th.
Divine, Thomas	February 18th, 1903.	April 22nd.
Eastwood, Arthur William	February 5th, 1903	April 22nd.
Edgerton, John Percy	February 5th, 1903	,, ,,
Elford, Archibald Sefton	December 4th, 1902	February 18th
Ellis, Henry Russel	November 5th, 1903.	December 3rd.
Fairhall, Edwin Jesse	April 2nd, 1903	June 17th.
Farmer, Robert Crosbie	December 17th, 1902.	February 18th.
Fawsitt, Charles Edward	November 5th, 1903.	December 3rd.
Fletcher, Alan	March 5th, 1903	April 22nd.
Forster, William	June 4th, 1903	December 3rd.
Friend, John Albert Newton	November 5th, 1903.	,, ,,
Candy, William Hunter	May 20th, 1903	June 17th.
Gardiner, Ernest Alexander	November 5th, 1903.	December 3rd.
Gatehouse, Frank Brooks	,, ,,	,, ,,
Gent, Percy William	June 17th, 1903	,, ,,
Gough, Henry	March 18th, 1903	April 22nd.
Grundy, Frank Barnes	November 5th, 1903.	December 3rd.
Hall, John T.	November 5th, 1903.	December 3rd.
Harmer, Francis Gerald	May 7th, 1903	June 17th.
Heasman, Harold Montague	November 5th, 1903.	December 3rd.
Hendrickson, Arthur V.	,, ,,	,, ,,
Hindmarsh, Leonard King	January 21st, 1903	February 18th.
Howarth, John George	November 5th, 1903.	December 3rd.
Howorth, Franklin Wise	January 21st, 1903	February 18th.
Howsam, George	February 5th, 1903	April 22nd.
Hughes, Edwin Reginald	June 4th, 1903	December 3rd.
Huyin, Moung Tha	December 4th, 1902	February 18th.
Hymans, Herbert	November 5th, 1903.	December 3rd.
Ibbotson, Edward Charles	November 5th, 1903.	December 3rd.
Jackson, William Henry	November 5th, 1903.	December 3rd.
Jennings, Walter Ernest	June 4th, 190	,, ,,
Jones, Alfred Owen	February 5th, 1903	April 22nd.
Kemp-Welch, Maurice	December 4th, 1902	February 18th.
Kent, Thomas Oliver	November 5th, 1903.	December 3rd.
Kerr, James Stewart	February 5th, 1903	April 22nd.
Kielty, John J.	November 5th, 1903.	December 3rd.
Kin, Thein	June 4th, 1903	,, ,,
King, Frank William George	May 7th, 1903	June 17th.
Kirkby, William	March 18th, 1903	April 22nd.
Knight, Harley Fancutt	November 5th, 1903.	December 3rd.
Laing, John	November 5th, 1903.	December 3rd.
Lamplough, Francis Edward Everard	November 5th, 1903.	,, ,,
Lawrence, Henry William	June 17th, 1903	,, ,,
Leadbetter, Harold Duff	November 5th, 1903.	,, ,,
Le Bas, Gervaise	,, ,,	,, ,,
Lees, Frederick Herbert	December 17th, 1902.	February 18th.

Name.	Proposed.	Elected.
Leigh, Arthur Graham	January 21st, 1903	February 18th.
Levy, Henry Wolff	April 2nd, 1903	June 17th.
Lewis, Harry Percy	November 19th, 1902	February 18th.
Linday, John Howard	May 20th, 1903	June 17th.
Livesey, Charles Edwin Leonard	May 7th, 1903	" "
Lock, John George Collcutt	March 18th, 1903	April 22nd.
Macdonald, David Baird	November 5th, 1903.	December 3rd.
Mander, Percy George	January 21st, 1903	February 18th.
Mann, Ernest William	November 5th, 1903.	December 3rd.
Mann, John Christopher	April 22nd, 1903	June 17th.
McMahon, Frederick William	November 5th, 1903.	December 3rd.
Monier-Williams, Gordon Wickham	" "	" "
Moore, Alfred Ernest	April 2nd, 1903	June 17th.
Moore, Arthur	May 20th, 1903	" "
Nairne, Urban Orlando Scotchburn	November 5th, 1903.	December 3rd.
Nevin, James Victor	" "	" "
Norman, George Marshall	April 2nd, 1903	June 17th.
O'Brien, Frederick	January 21st, 1903	February 18th.
Parry, George Harry	April 2nd, 1903	June 17th.
Parry, William	June 4th, 1903	December 3rd.
Pike, Henry George	November 5th, 1903.	" "
Pitt, Arthur Ernest	March 5th, 1903	April 22nd.
Pitt, Harold Russell	" "	" "
Plymen, George Horace Gladstone	November 5th, 1903.	December 3rd.
Pollard, William Branch	" "	" "
Pond, George Gilbert	March 18th, 1903	April 22nd.
Porter, Robert James	" "	" "
Prasad, Mata	November 5th, 1903.	December 3rd.
Prichard, George Montague	December 17th, 1902.	February 18th.
Purcell, Charles Stanley	May 7th, 1903	June 17th.
Redfern, Herbert Stanley	June 17th, 1903	December 3rd.
Rhind, Thomas	May 20th, 1903	June 17th.
Rich, Stiles William George	November 5th, 1903.	December 3rd.
Richardson, Harold Ernest	" "	" "
Robinson, Archibald Louis	February 18th, 1903.	April 22nd.
Robertson, Frederick	March 5th, 1903	" "
Robertson, Philip Wilfred	November 5th, 1903.	December 3rd.
Rogers, William David	" "	" "
Roose, Fitzroy Owen Jonathan	March 5th, 1903	April 22nd.
Samuel, Thomas	November 19th, 1902	February 18th.
Sawdon, Ernest William	March 18th, 1903	April 22nd.
Scholefield, Albert Henry	December 17th, 1902.	February 18th.
Senter, George	November 5th, 1903.	December 3rd.
Sibley, Samuel Edward	December 4th, 1902.	February 18th.
Siddle, George	February 5th, 1903	April 22nd
Slator, Arthur	November 5th, 1903.	December 3rd.
Smith, Charles Joseph	May 20th, 1903	June 17th.
Smith, Frank Gurney	June 17th, 1903	December 3rd.
Smith, James Cruickshank	April 2nd, 1903	June 17th.
Smith, William Veysey	November 5th, 1903.	December 3rd.
Steven, Alec Bowring	January 21st, 1903	February 18th.

Name.	Proposed.	Elected.
Stevens, Montague White	February 18th, 1903..	April 22nd.
Stevenson, Henry Edward	March 5th, 1903	,, ,,
Stewart, Alfred Walter	November 5th, 1903..	December 3rd.
Thomson, George Malcolm	January 21st, 1903	February 18th.
Tighe, Arthur	November 5th, 1903..	December 3rd.
Tilburn, Charles	December 17th, 1902.	February 18th.
Tolson, Stanley	January 21st, 1903	,, ,,
Toyne, Francis Digby	,, ,,	,, ,,
Turner, Arnold	November 5th, 1903..	December 3rd.
Turner, Duncan	December 4th, 1902..	February 18th.
Turner, William Ernest Stephen	November 5th, 1903..	December 3rd.
Tyrrell, Dennis	May 7th, 1903	June 17th.
Van Laer, Norbert	April 2nd, 1903	June 17th.
Wadmore, John Mello	November 19th, 1902.	February 18th.
Walker-Pole, Miles	November 5th, 1903..	December 3rd.
Walsh, Thomas Crosbie	January 21st, 1903	February 18th.
Weiss, Carl Friederich Richard	November 5th, 1903..	December 3rd.
Welsford, Giles Hadden	March 18th, 1903	April 22nd.
Wilkinson, James Bates	March 5th, 1903	,, ,,
Williams, David John	January 21st, 1903	February 18th.
Wilmore, Albert	November 19th, 1902	,, ,,
Wood, William Francis John	February 5th, 1903	April 22nd.
Woolhouse, Sidney Herbert	May 20th, 1903	June 17th.
Worden, Edward Chancey	February 5th, 1903	April 22nd.
Wright, Fred	November 5th, 1903 .	December 3rd.
Yeomans, William Wade	November 19th, 1902	February 18th.
Young, Andrew	December 17th, 1902.	,, ,,

FELLOWS DECEASED DURING 1903.

Name.	Elected.	Died.
*Adshead, Henry Guest	April 22nd	July 2nd.
Alexander, J. Owen	March 4th, 1897	September.
Barrows, Arthur Edward	June 16th, 1892	April 27th.
Bush, Baron William de	February 16th, 1882	July 24th.
Clift, Samuel	May 19th, 1856	May 5th.
Corfield, William Henry	March 1st, 1866	August 27th.
Demarçay, Eugene Anatole	December 15th, 1881	March 5th.
Fletcher, Thomas William	April 18th, 1872	September 20th.
Fulton, H. B.	March 1st, 1883	
Hendry, A. G.	December 1st, 1898	
James, Christopher	February 18th 1888	May 11th.
Lawson, Thomas Atkinson	February 2nd, 1888	June 2nd.
Mactear, James	April 21st, 1864	June 3rd.
Reddrop, Joseph	January 15th, 1874	
Robertson, George Henry	December 4th, 1890	July 5th.
Schunck, Edward	March 15th, 1842	January 13th.

* Did not pay Admission Fee.

TITLES OF PAPERS COMMUNICATED TO THE SOCIETY DURING 1903.

	Page in Proceedings.	Page in Transactions.
January 21st.		
1. Researches on silicon compounds. Part VIII. Interactions of silicophenylamide with thiocarbimides. By J. Emerson Reynolds	6	252
2. On the relation between the absorption spectra and the chemical structure of corydaline, berberine, and other alkaloids. By J. J. Dobbie and A. Lauder	7	605
3. The absorption spectra of laudanine and laudanosine in relation to their chemical constitution. By J. J. Dobbie and A. Lauder	9	626
4. Phenoc*yclo*heptene. By F. S. Kipping and A. E. Hunter	11	246
5. The influence of molybdenum and tungsten trioxides on the specific rotations of *l*-lactic acid and potassium *l*-lactate. By G. G. Henderson and J. Prentice	12	259
6. Estimation of ethyl alcohol in essences and medicinal preparations. By T. E. Thorpe and John Holmes	13	314
7. Carbon monoxide as a product of combustion of the Bunsen burner. By T. E. Thorpe	14	318
8. Derivatives of *β*-resorcylic acid and of protocatechuic acid. By W. H. Perkin, jun., and E. Schiess	14	159*
9. Synthesis of imino-ethers. *N*-Ethyl-, *N*-methyl-, and *N*-benzyl-benziminoethers. By G. D. Lander	15	320
10. The condensation of phenyl ethyl ketone (propiophenone) with benzalacetophenone and of acetophenone with benzalpropiophenone. By R. D. Abell	17	360
11. A synthesis of 1 : 3 : 5-triphenyl-2 : 4-dimethyl*cyclo*pentane and of 1 : 3 : 5-triphenyl-2-methyl*cyclo*pentane. By R. D. Abell	18	367
12. Formation of carbazoles by the interaction of phenols, in the orthoketonic form, with arylhydrazines. By F. R. Japp and W. Maitland	19	267
13. Dimorphism of α-methylanhydracetonebenzil. By F. R. Japp and A. C. Michie	20	276
14. The oxidation products of the methyl homologues of anhydracetonebenzil. By F. R. Japp and A. C. Michie	21	279
15. Action of hypobromites on amides. By A. Lapworth and W. W. S. Nicholls	22	—
16. Derivatives of menthyl cyanoacetate. By D. A. Bowack and A. Lapworth	22	42*

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17. The influence of nitro-groups on the reactivity of halogen derivatives of benzene. By A. Lapworth ...	23	—
February 5th.		
18. The solubilities and transition points of lithium nitrate and its hydrates. By F. G. Donnan and B. C. Burt	37	335
19. The synthesis of *as*-diglutaric acid By O. Silberrad and T. H. Easterfield	38	—
20. Distillation of chlorine water. By A. Richardson	39	380
21. A new vapour density apparatus. By John S. Lumsden	40	342
22. A new form of pyrometer. By John S. Lumsden	41	349
23. Tertiary butylphenol. By E. W. Lewis	41	329
February 18th.		
24. The molecular rearrangement of *N*-substituted imino-ethers. By G. D. Lander	45	406
25. The nature and probable mechanism of the replacement of metallic by organic radicles in tautomeric compounds. By G. D. Lander	47	414
26. The chlorine derivatives of pyridine. Part VIII. The interaction of 2 : 3 : 4 : 5-tetrachloropyridine with ethyl sodiomalonate. By W. J. Sell and F. W. Dootson	48	396
27. The biological method for resolving inactive acids into their optically active components. By A. McKenzie and A. Harden	48	424
28. Colour changes observed in solutions of cobalt chloride. By W. N. Hartley	49	401
29. The action of ammonia and organic bases on ethyl esters of olefinedicarboxylic and olefine-β-ketocarboxylic acids. By S. Ruhemann	50	374
30. Derivatives of *p*-aminoacetophenone. By F. D. Chattaway	50	—
March 5th.		
31. The mechanism of the reduction of potassium bichromate by sulphurous acid. By H. Bassett, jun.	54	692
32. The constitution of pilocarpine. Part IV. By H. A. D. Jowett	54	438
33. Preparation and properties of 1 : 4(or 1 : 5)-dimethylglyoxaline and 1 : 3-dimethylpyrazole. By H. A. D. Jowett and C. E. Potter	56	464
34. Camphor-β-thiol. By T. M. Lowry and G. C. Donington.....	57	479
35. Isomeric change of dibenzanilide into benzoyl-*o*-amino- and benzoyl-*p*-amino-benzophenones. By F. D. Chattaway	57	—

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36. Formation of purpurogallin by the electrolytic oxidation of pyrogallol. By A. G. Perkin and F. M. Perkin...	58	—
37. The analysis of *Reh*, the alkaline salts in Indian usar land. By E. G. Hill	58	—
38. Experiments on the synthesis of camphoric acid. Part III. Synthesis of *iso*lauronolic acid. By W. H. Perkin, jun., and J. F. Thorpe.....	61	—
39. The rate of decomposition of diazo-compounds. Part III. The temperature-coefficient. By J. C. Cain and F. Nicoll.....	63	470
40. An analysis of the natural gas at Heathfield, Sussex. By H. B. Dixon and W. A. Bone	63	—
41. Chemical composition of cooked vegetable foods. By Miss K. I. Williams	66	—
42. The density of nitric oxide. Preliminary notice. By R. W. Gray.....	66	—
43. Hydrolysis of urea hydrochloride. By J. Walker and J. K. Wood...	67	484
44. The affinities of some feebly basic substances. By J. K. Wood	67	568
March 18th.		
45. Essential oil of hops. By A. C. Chapman	72	505
46. A compound of dextrose with aluminium hydroxide. By A. C. Chapman	74	—
47. Action of phosphorus haloids on dihydroresorcins. Part II. Dihydroresorcin. By A. W. Crossley and P. Haas	75	494
48. The constitution of cotarnine. By J. J. Dobbie, A. Lauder, and C. K. Tinkler...	75	598
49. Decomposition of mercurous nitrite by heat. By P. C. Rây and J. N. Sen.....	78	491
50. The action of nitrogen tetroxide on pyridine. By J. F. Spencer	79	—
April 2nd.		
51. The dioximes of camphorquinone, and other derivatives of *iso*nitrosocamphor. By M. O. Forster	97	514
52. Reversibility of enzyme or ferment action. By A. C. Hill	99	578
53. Discoloured rain. By E. G. Clayton.....	101	—
54. The absorption spectra of nitric acid in various states of concentration. By W. N. Hartley	103	658
55. Salts of an isomeric mercaptoid form of thioallophanic acid, and a new synthesis of alkyl iminothiocarbamates. By A. E. Dixon.....	104	550
56. Derivatives of *o*-aminobenzophenone and *p*-aminobenzophenone. By F. D. Chattaway	106	—

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57. Action of caustic alkalis on cinnamic acid dibromide and its esters. By J. J. Sudborough and K. J. Thompson	106	666
58. The composition of Caro's acid. By T. S. Price	107	543
April 22nd.		
59. The velocity and mechanism of the reaction between potassium ferricyanide and potassium iodide in neutral aqueous solution. By F. G. Donnan and R. Le Rossignol	120	703
60. A microscopic method of determining molecular weights. A preliminary note. By G. Barger	121	—
61. Note on the spectrum of pilocarpine nitrate. By W. N. Hartley	122	—
62. Isomeric change of dipropionanilide into propionyl-*p*-aminopropiophenone. By F. D. Chattaway	124	—
63. Note on the formation of di- and hexa-methylammoniocadmium chlorides. By W. R. Lang	125	724
May 7th.		
64. The action of ammonia and organic bases on ethyl esters of olefinedicarboxylic and olefine-β-ketocarboxylic acids. Part II. By S. Ruhemann	128	717
65. Spontaneous decomposition of nitrocamphor. By T. M. Lowry	129	953
66. β-Bromo-ϵ'-nitrocamphor and β-and π-bromocamphoryloximes. The influence of impurities in conditioning isomeric change. By T. M. Lowry	129	953
67. The electrolytic reduction of pheno- and naphthomorpholones. By F. H. Lees and F. Shedden	132	750
68. The coloured constituents of *Butea frondosa*. By R. G. Hill	133	—
69. Butein. A preliminary notice. By (the late) J. J. Hummel and A. G. Perkin	134	—
70. The relative affinities of polybasic acids. By H. M. Dawson	135	725
71. The chemical dynamics of the reactions between chlorine and benzene under the influence of different catalytic agents and of light. By A. Slator.	135	729
72. The diazo-reaction in the diphenyl series. Part I. On dianisidine and 3 : 3′-dichlorobenzidine. By J. C. Cain	136	688
May 20th.		
73. The conditions of decomposition of ammonium nitrite. By V. H. Veley	142	736
74. Freezing point curves for some binary mixtures of organic substances, chiefly phenols and amines. By J. C. Philip	143	814

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75. Isomeric partially racemic salts containing quinquevalent nitrogen. Part XI. Derivatives of *dl*-methylhydrindamine and *dl-neo*-methylhydrindamine. Isomeric salts of the type $NR_1R_2H_2$. By G. Tattersall and F. S. Kipping	145	918
76. The action of liquefied ammonia on chromic chloride. By W. R. Lang and C. M. Carson	147	—
77. Note on the action of methylamine on chromic chloride. By W. R. Lang and E. H. Jolliffe	147	—
78. Cholesterol. Preliminary note. By R. H. Pickard and J. Yates	147	—
79. Hydrogen cyanide in fodder plants. By J. C. Brünnich	148	788
80. Sulphocampholenecarboxylic acid. By A. W. Harvey and A. Lapworth	148	1102
81. Optically active esters of β-ketoic and β-aldehydic acids. Part III. Azo-derivatives of menthyl acetoacetate. By A. Lapworth	149	1114
82. The chemical reactions involved in the rusting of iron. By W. R. Dunstan	150	—
June 4th.		
83. Formation of an anhydride of camphoryloxime. By T. M. Lowry	156	953
84. Mutarotation of glucose as influenced by acids, bases, and salts. By T. M. Lowry	156	1314
85. The solubility of dynamic isomerides. By T. M. Lowry	156	—
86. The rusting of iron. By G. T. Moody	157	—
87. Imino-ethers corresponding with ortho-substituted benzenoid amides. By G. D. Lander and F. T. Jewson	160	766
88. The hydrolysis of ethyl mandelate by lipase. By H. D. Dakin	161	—
89. Isomeric change in benzene derivatives. The conditions influencing the interchange of halogen and hydroxyl in benzenediazonium hydroxides. By K. J. P. Orton	161	796
90. The synthesis of $\alpha\alpha\gamma$-trimethylglutaric acid, of the *cis*- and *trans*-modifications of β-hydroxy-$\alpha\alpha\gamma$-trimethylglutaric acid, and of $\alpha\alpha\gamma$-trimethylglutaconic acid. By W. H. Perkin, jun., and Alice E. Smith	163	771
91. Hexamethyleneoctocarboxylic acid and the *cis*- and *trans*-modification of hexamethylenetetracarboxylic acid (hexahydropyromellitic acid). By T. W. D. Gregory and W. H. Perkin, jun.	163	780
92. The bases contained in Scottish shale oil. Part II. By F. C. Garrett and J. A. Smythe	164	763
93. A direct method for determining the latent heat of evaporation. By J. Campbell Brown	164	987
94. Isomeric partially racemic salts containing quinquevalent nitrogen. Part X. The four isomeric hydrindamine *d*-chlorocamphorsulphonates, $NR_1R_2H_2$. By F. S. Kipping	164	902

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95. Isomeric compounds of the type $NR_1R_2H_3$. By F. S. Kipping	166	937
June 17th.		
96. The estimation of arsenic in fuel. By T. E. Thorpe.	182	969
97. The electrolytic estimation of minute quantities of arsenic, more especially in brewing materials. By T. E. Thorpe	183	974
98. Crystallised ammonium sulphate and the position of ammonium in the alkali series. By A. E. H. Tutton	185	1049
99. The action of hydrogen on sodium. By A. Holt, jun.	187	—
100. The action of halogens on compounds containing the carbonyl group. By Arthur Lapworth	188	30*
101. Reactions involving the addition of hydrogen cyanide to carbon compounds. By A. Lapworth	189	995
102. The aceto-acetic ester synthesis. By A. C. O. Hann and A. Lapworth	189	—
103. Rimu resin By T. H. Easterfield and B. C. Aston	190	—
104. Note on the karaka fruit. By T. H. Easterfield and B. C. Aston	191	—
105. The slow oxidation of methane at low temperatures. II. By W. A. Bone and R. V. Wheeler	191	1074
106. The alkylation of sugars. By T. Purdie and J. C. Irvine	192	1021
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ADDITIONS TO THE LIBRARY DURING THE YEAR 1903.

Abegg, R. Die Theorie der elektrolytischen Dissociation. pp. viii + 110. Stuttgart 1903.

—— *See* Guldberg, C. M.

Ackroyd, William. On the circulation of salt and its bearing on geological problems, more particularly that of the geological age of the earth. (From the *Proc. Yorks. Geol. Poly. Soc.*, 1902.)

Ador, E. *See* Marignac, J.-C. G.

Albo, Giacomo. Alcune considerazioni sul significato fisiologico degli alcaloidi vegetali. (From the *Nuovo Giorn. bot. ital.*, 1902.)

Allan, G. E. *See* Klöcker, A.

Anschütz, R. *See* Richter, V. von.

Archambault, P. J. *See* Violette, J. H. M.

Armsby, Henry Prentiss. The principles of animal nutrition. With special reference to the nutrition of farm animals. pp. 614. New York and London 1903.

Aschan, Ossian. Die Konstitution des Kamphers und seiner wichtigsten Derivate. pp. 118. Braunschweig 1903.

Baccioni, G. B. Dall 'Alchimia alla Chimica. pp. vi + 446. Torino 1903.

Baumé, Antoine. Mémoire sur la meilleure manière de construire les alambics et fourneaux propres à la distillation des vins pour en tirer les eaux-de-vie. pp. viii + 128. ill. Paris 1778.

Beadle, C. *See* Cross, C. F.

Bellati, M., and Finazzi, L. Sul calore che si produce bagnando le polveri. (From the *Atti R. Inst. Veneto.*, 1902.)

Betti, Mario. β-Naftossazine e composti affini contenenti radicali aldeidici e chetonici misti. (From the *Gazz. Chim. Ital.*, 33, I, 1903.)

—— Sulla funzione delle basi β-naftol-aldaminiche. (From the *Gazz. Chim. Ital.*, 33, I, 1903.)

—— Reazione generale di condensazione fra β-naftolo, aldeidi e amine. (From the *Gazz. Chim. Ital.*, 33, pt. I, 1903.)

Bevan, E. J. *See* Cross, C. F.

Bigelow, W. D. Foods and food control. Parts I—V. (*Being* U.S. Dept. of Agriculture, Bureau of Chemistry, Bulletin No. 69.) Washington 1902.

Bloxam, Charles Loudon. Chemistry, inorganic and organic. With experiments. 9th edition. By John Millar Thomson and Arthur G. Bloxam. pp. xii + 872. ill. London 1903.

Bömer, A. *See* König, J.

Bolton, Henry Carrington. Contributions of alchemy to numismatics. pp. 44. ill. New York 1890.

Borchers, Wilhelm. Das neue Institut für Metallhüttenwesen und Elektrometallurgie an der königlichen technischen Hochschule zu Aachen (Abschnitt. Elektrische Messinstrumente). Halle 1903.

—— Elektro-Metallurgie. Die Gewinnung der Metalle unter Vermittlung des elektrischen Stromes. 3rd ed. pp. 578. ill. Leipzig 1902.

—— Elektro-Metallurgie des Nickels. pp. 36. ill. (*Being part of* Bd. VI. Monographien über angewandte Elektrochemie.) Halle 1903.

Borns, Henry. Die Elektrochemie im Jahre 1896, (1897—1901).

Boyle, Robert. De ipsa natura, sive libera in receptam naturæ notionem disquisitio ad amicum. pp. xxii + 181. London 1687.

Browning, Philip E. Introduction to the rarer elements. pp. viii + 158. New York 1903.

Buchner, Eduard, Buchner, Hans, and Hahn, Martin. Die Zymasegärung, Untersuchungen über den Inhalt der Hefezellen und die biologische Seite des Gärungsproblems. pp. 416. München 1903.

Bull, Irving C. On the determination of lead in ores. (From the *School of Mines Quarterly*, 1902, 23, p. 348.)

Citron or Cedrat Oil (*Citrus Medica*). A review of recent research work on the constants of this oil. pp. 7. 1903.

Clemm, W. N. Die Gallensteinkrankheit, ihre Häufigkeit, ihre Entstehung, Verhütung und Heilung durch innere Behandlung. pp. 90. Berlin 1903.

Clough, W. T., and Dunstan, A. E. Elementary experimental science. pp. 239. ill. London 1904.

Clowes, Frank, and Coleman, Joseph Bernard. Elementary practical chemistry. Part I. General chemistry. 4th edition. pp. xvi + 198. ill. London 1903.

—— Quantitative chemical analysis, adapted for use in the laboratories of colleges and schools. 6th ed. pp. xxiv + 602. ill. London 1903.

Cohen, Julius Berend. Theoretical organic chemistry. pp. 578. ill. London 1902.

Coleman, J. B. *See* Clowes, F.

Collins, Sidney Hoare. Composition of Milk in the North of England. (From the *Journ. Soc. of Chem. Ind.*, 21, 1902.)

—— Sugar in Swedes. Part II. (From the *Journ. Soc. of Chem. Ind.*, 21, 1902.)

Colorado. The University of Colorado Studies. Vol. I. No. 2. 1902.

Cooke, A. G. *See* Groves, C. E.

Cooper, H. C. *See* Holleman, A. F.

Crookes, W. On the manufacture of beetroot sugar in England and Ireland. pp. xvi + 290 + xii. ill. London 1870.

Cross, C. F., Bevan, E. J., Beadle, Clayton, and Sindall, R. W. C.B.S. Units and standard paper tests. An essay towards establishing a normal system of paper testing. pp. 25. London 1903.

Cutolo, Alessandro. Brodo di sangue (nuovo terreno di cultura). (From the *Boll. Soc. Nat. Napoli*, 16, 1902.)

—— Contributo all' analisi degli olii. (From the *Boll. Soc. Nat. Napoli*, 15, 1901.)

—— Sulla ricerca delle sostanze coloranti artificiali negli alimenti in decomposizione. (From the *Boll. Soc. Nat. Napoli*, 15, 1901.)

Danger, Ferdinand Philippe. The art of glass-blowing, or plain instructions for making the chemical and philosophical instruments which are formed of glass. pp. 112. ill. London 1831.

Deutschen Landwirtschafts-Gesellschaft Arbeiten. Heft 80. Die Düngung mit schwefelsaurem Ammoniak und organischen Stickstoffdüngern im Vergleich zum Chilisalpeter. Berlin 1903.

—— Heft 81. Untersuchungen über den Wert des neuen 40 prozent. Kalidüngesalzes gegenüber dem Kainit. Berlin 1903.

Dibdin, William Joseph. Public lighting by gas and electricity. pp. xx + 537. ill. London 1902.

—— *See* Groves, C. E.

Doane, Charles F., and Price, T. M. The influence of preservatives upon the food value of milk. (Bull. No. 86, Maryland Agric. Exper. Station, 1902.)

Donnan, F. G. *See* Mayow, J.

Duhem, P. Thermodynamics and chemistry. A non-mathematical treatise for chemists and students of chemistry. Authorized translation by G. K. Burgess. pp. xxii + 445. ill. New York 1903.

Dunstan, A. E. *See* Clough, W. T.

Dyer, Bernard, and Shrivell, F. W. E. The manuring of market garden crops. (From the *Journal of the Royal Horticultural Society*, 27, 1903.)

Elbs, Karl. Electrolytic preparations. Exercises for use in the laboratory by chemists and electro-chemists. Translated by R. S. Hutton. pp. 100. ill. London 1903.

Ellis, C. Sordes. Elementary chemistry of photographic chemicals. pp. 120. ill. London 1903.

Everett, Alice. *See* Hovestadt, H.

Everett, J. D. *See* Hovestadt, H.

Fairley, T. On writing and printing inks. (From the *Journal of the Society of Dyers and Colourists, July*, 1903.)

Ferchland, P. Grundriss der reinen und angewandten Elektrochemie. pp. 271. ill. Halle 1903.

Finazzi, L. *See* Bellati, M.

Fischer, E. Synthesen in der Purin- und Zuckergruppe. pp. 29. Braunschweig 1903.

Frankland, E. Autobiographical sketches from the life of Sir Edward Frankland, K.C.B., F.R.S. Edited and concluded by his two daughters, M. N. W. and S. J. C. pp. 480. London 1902.

Freer, Paul C. The preparation of benzoylacetylperoxide, and its use as an intestinal antiseptic in cholera and dysentery. Manila 1902.

Frühling, Robert. Anleitung zur Untersuchung der für die Zuckerindustrie in betracht kommenden Rohmaterialien, Produkte, Nebenprodukte, und Hilfssubstanzen. 6th edition. pp. xxi+505. ill. Braunschweig 1903.

Garland, A. La industria del petróleo en el Perú en 1901. (*Being* Boletin del Cuerpo de Ingenieros de Minas del Peru No. 2.)

Garola, C. V. Engrais. pp. 502. Paris 1903.

Gauss, Carl Friedrich. Allgemeine Grundlagen einer Theorie der Gestalt von Flüssigkeiten im Zustand des Gleichgewichts. Uebersetzt von R. H. Weber. Hrsg. von H. Weber. (Ostwald's *Klassiker*, No. 135.) Leipzig 1903.

Georgievics, G. von. Chemistry of dyestuffs, translated from the second German edition by Charles Salter. pp. 402. London 1903.

Glaser, Christopher. The Compleat Chymist, or a New Treatise of Chymistry. Teaching by a short and easy method all its most necessary Preparations. Written in *French* by *Christopher Glaser*, Apothecary in Ordinary to the *French King*, and the *Duke of Orleans*. And from the fourth Edition, Revised and Augmented by the Author. *Now* faithfully *Englished* by a *Fellow* of the *Royal Society*. Illustrated with Copper Plates. pp. 286. London 1677.

Glasgow. Corporation Water Works. Reports on the supply of water to the city. 1853—1855.

Golding, John. A domesticated microbe. (From the *Proc. Nottingham Naturalist's Society*, 1903.)

—— Experiments on peas in water culture. (From the *Centralblatt f. Bakteriologie Abt. II., XI.*)

Grandeau, Louis. Valeur et rôle alimentaires du sucre chez l'homme et chez les animaux. pp. 145. Paris 1903.

Gregory, William. A handbook of inorganic chemistry; being a new and greatly enlarged edition of the "Outlines of inorganic chemistry." 3rd ed. pp. 291. ill. London 1853.

Groves, Charles Edward, and Thorp, William. Chemical technology or chemistry in its applications to arts and manufactures. With which is incorporated Richardson and Watts' Chemical Technology. Vol. III. Gas lighting, by Charles Hunt. Vol. IV. Electric lighting, by A. G. Cooke, Photometry by William Joseph Dibdin. ill. London 1903.

Guldberg, C. M. Thermodynamische Abhandlungen über Molekulartheorie und chemische Gleichgewichte 1867—1872. Uebersetzt und hrsg. von R. Abegg. (Ostwald's *Klassiker*, No. 139.) Leipzig 1903.

Guthrie, Frederick Bickell. Analysis of prickly pear. 1900.

Hahn, M. *See* Buchner, E.

Hall, A. D. The continuous growth of mangels for twenty-seven years on the same land, Barn Field, Rothamsted. (From the *Journ. of the Royal Agricultural Society of England*, 63, 1902.)

—— *See* Voelcker, J. A.

Haller, Albin. Les industries chimiques et pharmaceutiques. 2 Tome. pp. lxxxix + 405, 445. ill. Paris 1903.

Harper, Henry Winston. A contribution to the chemistry of some of the asphalt rocks found in Texas. Austin, Texas 1902.

Harrison, John Burchmere. Report on the agricultural work in the Botanic Gardens and the Government Laboratory for the years 1896—1901. British Guiana, Georgetown, Demerara 1902.

Hart, E. B. *See* Van Slyke, L. L.

Hartley, Harold. Polymorphism. An historical account. pp. 29. Oxford 1902.

Hassack, Paul. Gärungs-Essig. pp. xvi + 404. ill. Wien 1904.

Hausbrand, E. Die Wirkungsweise der Rektifizier-und Destillier-Apparate mit Hilfe einfacher mathematischer Betrachtungen. 2 Aufl. pp. 114. ill. Berlin 1903.

Hebb, Thomas C. On a determination of the freezing-point depression constant for electrolytes. (From the *Trans. Nov. Scot. Inst. Sc.*, 1902.)

Heermann, Paul. Koloristische und textilchemische Untersuchungen. pp. 398. ill. Berlin 1903.

Hellot, Jean. Färbekunst oder Unterricht, Wolle und wollene Zeuge zu färben; nebst Vorschriften wegen der Prüfungen durch

Absieden. Aus dem französischen übersetzt von Abraham Gotthelf Kästner. Zwente Auflage, welcher eine Nachricht von der Seidenfärberen. pp. 468. Altenburg 1765.

Henri, Victor. Lois générales de l'action des diastases. pp. xii + 129. Paris 1903.

Henry, T. A. Aids to chemistry. pp. 316. London 1903.

Herrera, A. L. Le protoplasma de métaphosphate de chaux. Mexico 1902.

Herzberg, Wilhelm. Papierprüfung. Eine Anleitung zum Untersuchen von Papier. 2nd ed. pp. 146. ill. Berlin 1902.

Höber, Rudolf. Physikalische Chemie der Zelle und der Gewebe. pp. 344. ill. Leipzig 1902.

Hoff, Jacobus Henricus van't. Physical chemistry in the service of the sciences. English version by A. Smith. pp. xviii + 126. ill. Chicago 1903.

—— Vorlesungen über theoretische und physikalische Chemie. Zweites Heft. Die chemische Statik. 2nd ed. pp. x + 150. ill. Braunschweig 1903.

Hofmann, Karl. Die radioactiven Stoffe nach dem gegenwärtigen Stande der wissenschaftlichen Erkenntnis. pp. 54. Leipzig 1903.

Holleman, Arnold Frederick. A text-book of inorganic chemistry, rendered into English with the co-operation of the author by Hermon C. Cooper. pp. 458. ill. New York and London 1902.

—— Textbook of organic chemistry, translated from the second Dutch edition by A. J. Walker, assisted by O. E. Mott. New York 1903.

Hoppe-Seyler, Ernst Felix Immanuel. Handbuch der physiologisch- und pathologisch-chemischen Analyse für Aerzte und Studirende. Edited by H. Thierfelder. 7th ed. pp. xv + 618. ill. Berlin 1903.

Horstmann, A. Abhandlungen zur Thermodynamik chemischer Vorgänge. Hrsg. von J. H. van't Hoff. (Ostwald's *Klassiker*, No. 137.) Leipzig 1903.

Hovestadt, H. Jena glass, and its scientific and industrial applications, translated and edited by J. D. Everett and Alice Everett. London 1903.

Hoyer, Egbert, und Kreuter, Franz. Technologisches Wörterbuch. Band I. Deutsch-Englisch-Französisch. Band II. Englisch-Deutsch-Französisch. Band III. Französisch-Deutsch-Englisch. 5 Aufl. pp. 884, 877, 790. Wiesbaden 1904.

Hunt, C. *See* Groves, C. E.

Hutton, R. S., and Petavel, J. E. High temperature electrochemistry. Notes on experimental and technical electric furnaces. Manchester 1902.

International Catalogue of Scientific Literature. First Annual Issue. C. Physics, Part 1 and 2; D. Chemistry, Part 1 and 2; G. Mineralogy, including petrology and crystallography; Q. Physiology, Part 1 and 2; R. Bacteriology. London 1902—1903.

Jolin, S. *See* Nilson, L. F.

Jünemann, Friedrich. Die Brikett-Industrie und die Brennmaterialien. pp. 320. ill. Wien 1903.

Kästner, A. G. *See* Hellot, J.

Kinch, Edward. Manurial experiments on permanent grass at the Royal Agricultural College, Cirencester. (From the *Agricultural Students' Gazette*, Dec. 1902.)

Klaproth, Martin Henry. Analytical essays towards promoting the chemical knowledge of mineral substances. Translated from the German. London 1801.

Klöcker, Alb. Fermentation organisms. A laboratory hand-book. Translated from the German by G. E. Allan and J. H. Millar, and revised by the author. pp. 392. ill. London 1903.

König, J. Chemie der menschlichen Nahrungs-und Genussmittel. Vol. I, Chemische Zusammensetzung der menschlichen Nahrungs-und Genussmittel. Nach vorhandenen Analysen mit Angabe der Quellen zusammengestellt. 4 Aufl. Hrsg. von A. Bömer. pp. xviii + 1535. ill. Berlin 1903.

Koenigsberger, Leo. Hermann von Helmholtz. 3 vols. pp. 376, 383, 142. ill. Braunschweig 1902.

Kohut, Adolph. Justus von Liebig. Sein Leben und Wirken. pp. 394. ill. Giessen 1904.

Kreuter, F. *See* Hoyer, E.

Labonne, Henry. Formulaire pratique des parfums et des fards. pp. 218. ill. Paris 1903.

Landolt, Hans. Assisted by Schönrock, O., Lindner, P., Schütt, F., Berndt, L., and Posner, T. The optical rotating power of organic substances, and its practical applications. Authorized translation with additions by J. H. Long. pp. xxii + 752. ill. Easton, Pa. 1902.

Lang, H. Das chemische Laboratorium an der Universität in Heidelberg. ill. Carlsruhe 1858.

—— *See* Weltzien, K.

Langworthy, C. F. The functions and uses of foods. (U.S. Dept. of Agric. Office of Experiment Stations Circular No. 46.)

Lassar-Cohn, ——. Arbeitsmethoden für organisch-chemische Laboratorien, ein Handbuch für Chemiker, Mediziner, und Pharmazeuten. 3rd ed. pp. 1076. ill. Hamburg 1902.

—— The praxis of urinary analysis. A guide to the chemical analysis of urine. With directions for preparing artificial pathological urines for practising the various tests, and an appendix on the analysis of stomach contents. Authorized translation by H. W. F. Lorenz. pp. vi + 58. New York 1903.

Lehfeldt, Robert A. A text-book of physics: with sections on the application of physics to physiology and medicine. pp. viii + 304, ill. London [1902].

Lévy, Lucien. Les moûts et les vins en distillerie. pp. 651. ill. Paris 1903.

Liebreich, Oscar. Ueber die Wirkung der Borsäure und des Borax. (Ein zweites Gutachten.) pp. 80. ill. Berlin 1903.

Lindner, Paul. Atlas der mikroskopischen Grundlagen der Gärungskunde mit besonderer Berücksichtigung der biologischen Betriebskontrolle. 111 Tafeln mit 418 Einzelbildern. Berlin 1903.

—— *See* Landolt, H.

Liversidge, A. The Boogaldi, Barratta Nos. 2 and 3, Gilgoin Nos. 1 and 2, and Eli Elwah or Hay Meteorites, New South Wales. (From the *Journal and Proceedings of the Royal Society of N.S. Wales*, 36.)

Lodge, Sir Oliver. Modern Views on Matter. (Romanes Lecture 1903.) pp. 27. Oxford 1903.

London Essence Co. Half yearly report. Nos. 1 and 2. London 1903.

Lorenz, H. W. F. *See* Lassar-Cohn.

Low, David. An inquiry into the nature of the simple bodies of chemistry. 2nd ed. pp. 344. London 1848.

Lüpke, Robert. Grundzüge der Elektrochemie auf experimenteller Basis. 4th ed. pp. xii + 286. ill. Berlin 1903.

M'Gowan, G. *See* Ostwald, W.

Mahler, P. Études sur les combustibles, solides, liquides et gazeux. pp. x + 95. ill. Paris 1903.

Marignac, Jean-Charles Galissard de. Œuvres complètes, publiées hors série sous les auspices de la Société de physique et d'histoire naturelle de Genève: par E. Ador. Tome ii. Mémoires et critiques, 1860—1887. pp. 839. Geneva 1903.

Mathias, E. Le point critique des corps purs. pp. viii + 255. ill. Paris 1904.

Mayow, John. Untersuchungen über den Salpeter und den salpetr-

igen Luftgeist, das Brennen und das Athmen. Herausgegeben von F. G. Donnan. (Ostwald's *Klassiker*, No. 125.) Leipzig 1901.

Meunier, Louis, and Vaney, Clément. La tannerie. Etude, préparation et essai des matières premières, théorie et pratique des différentes méthodes actuelles de tannage, examen des produits fabriqués, publié sous la direction de Léo Vignon. pp. 648. ill. Paris 1903.

Meyer, Dr. H. Determination of Radicles in Carbon Compounds. Authorised translation by J. Bishop Tingle. 2nd edition. pp. xii + 162. ill. New York 1903.

Millar, J. H. *See* Klöcker, A.

Mitchell, C. A. *See* Wright, C. R. A.

Mott, O. E. *See* Holleman, A. F.

Mulder, Gerardus Joannes. Bijdragen tot de geschiedenis van het scheikundig gebonden water (being *Derde stuk, derde deel* of *Scheikundige verhandelingen en onderzoekingen*). pp. 352. Rotterdam 1864.

Naske, Carl. Die Portland-Cement-Fabrikation. Ein Handbuch für Ingenieure und Cementfabrikanten. pp. 302. ill. Leipzig 1903.

National Physical Laboratory. Reports for years 1901–2.

Nilson, Lars Fredrik, and Jolin, Severin. Minnesfesten öfver Berzelius den 7 Oktober 1898. Beskrifning på uppdrag af Kungl. Vetenskapsakademien. Stockholm [1901].

Ostwald, W. Scientific foundations of analytical chemistry, treated in an elementary manner. Translated by George M'Gowan. pp. 215. London 1900.

Pairault, E. A. Le rhum et sa fabrication. pp. 292. ill. Paris 1903.

Parkes, Samuel. A chemical catechism for the use of young people: with copious notes for the assistance of the teacher; to which are added a vocabulary of chemical terms, useful tables, and a chapter of amusing experiments. pp. 607. ill. London 1806.

Patten, Harrison Eastman. Influence of the solvent in electrolytic conduction. (From the *Journ. Phys. Chem.*, 1902.)

Petavel, J. E. *See* Hutton, R. S.

Plimmer, Robert Henry Aders. The chemical changes and products resulting from fermentations. pp. 184. London 1903.

Posner, Theodor. Lehrbuch der synthetischen Methoden der organischen Chemie. pp. xxxii + 436. Leipzig 1903.

—— *See* Landolt, H.

Rây, Praphulla Chandra. A history of Hindu chemistry from the earliest times to the middle of the sixteenth century A.D. with

Sanskrit texts, variants, translation, and illustrations. Vol. I. pp. 176 + xli. London 1902.

Reynolds, Osborne. The sub-mechanics of the universe. Published for the Royal Society of London. pp. xvii + 254. Cambridge 1903.

Richter, V. von. Chemie der Kohlenstoffverbindungen oder organische Chemie. Zehnte Auflage. Bearbeitet von R. Anschütz in Gemeinschaft mit G. Schroeter. Vol. I. Die Chemie der Fettkörper. pp. 746. ill. Bonn 1903.

Rideal, Samuel. Glue and glue testing. pp. 144. ill. London 1900.

Rideal, Samuel, and Walker, T. Ainslie. Standardisation of disinfectants. (From the *Journal of the Sanitary Institute*, 24, 3.)

Roesler, Leonhard. Mittheilungen über die Arbeiten der K.K. chemisch-physiologischen Versuchs-station für Wein- und Ostbau zu Klosterneuburg bei Wien bis Ende Juli 1902. Heft. VI. ill. Wien u. Leipzig 1902.

Salter, C. *See* Georgievics, G.

Schaer, Ed. Ueber die Verwendung des Chloralhydrates bei Drogen-und Nahrungsmittelprüfungen, toxikologisch-chemischen Untersuchungen und technischen Expertisen. (From the *Berichte der Deutschen Pharmaceutischen Gesellschaft*, 1903, *Hft.* 6.)

Schiff, Ugo. Separazione delle funzioni basica ed acida per mezzo della formaldeide. (From the *Gazz. Chim. Ital.*, 33, I, 1903.)

Schnabel, Carl. Lehrbuch der allgemeinen Hüttenkunde. 2nd ed. pp. xvi + 757. ill. Berlin 1903.

Schönrock, O. *See* Landolt, H.

Schroeter, G. *See* Richter, V. von.

Schucht, Ludwig. Die Fabrikation des Superphosphats mit Berücksichtigung der anderen gebräuchlichen Düngemittel. Handbuch für den Düngerchemiker im Betriebe und im Laboratorium. 2 Aufl. pp. 336. ill. Braunschweig 1903.

Schütt, F. *See* Landolt, H.

Seubert, Karl. Internationale Atomgewichte von 1903. Leipzig 1903.

Shrivell, F. W. E. *See* Dyer, B.

Sindall, R. W. *See* Cross, C. F.

Smith, Alexander, and Holmes, Willis B. On amorphous sulphur. (University of Chicago Decennial Publications.) pp. 12. Chicago 1902.

Sorel, Emile. La grande industrie chimique minérale. pp. 679. ill. Paris 1904.

Speroni, C. Di alcuni derivati aldeidici del solfito di anilina. (From the *Gazz. Chim. Ital.*, 33, I, 1903.)

Spiegel, Leopold. Der Stickstoff un seine wichtigsten Verbindungen. pp. 911. Braunschweig 1903.

Sprengel, Hermann. The discovery of picric acid (Melinite, Lyddite) "as a powerful explosive" and of cumulative detonation with its bearing on wet guncotton. Second edition. London 1903.

Stieglitz, Julius. On the "Beckmann rearrangement." (University of Chicago Decennial Publications.) Chicago 1903.

Stocks, Herbert Birtwhistle, and White, H. Graham. Sizing and sizing materials. (From the *Journ. Soc. Chem. Ind.*, 1903.)

Storer, Francis Humphreys. Testing for mannose. (From the *Bulletin of the Bussey Institution*, 1902.)

Taylor, Robert Llewellyn. I, On a higher oxide of cobalt. II, A method for the volumetric determination of cobalt. (From the *Memoirs and Proceedings of the Manchester Literary and Philosophical Society*, 47, 1902—1903.)

—— On the reaction of iodine with mercuric oxide in presence of water. (From the *Memoirs and Proc. Manchester Lit. and Phil. Soc.*, 47.)

Thierfelder, H. *See* Hoppe-Seyler, E. F. I.

Thomsen, Julius. Fremgangsmaade, ved hvilken det hidtil hypotetiske stof Enkeltsvovlkulstof (CS) med lethed kan dannes. 1902.

Thorp, W. *See* Groves, C. E.

Thwaite, B. H. The effect of flue dust upon the thermal efficiency of hot-blast stoves. (From the *Journal of the Iron and Steel Institute*, 1903, I.)

Tingle, J. B. *See* Meyer, H.

Van Slyke, L. L. Some facts about commercial fertilizers in New York State. (*Being* Bull. No. 230, New York Agric. Exper. Station, 1903.)

Van Slyke, L. L., and Hart, E. B. Some of the compounds present in American cheddar cheese. (*Being* Bull. No. 219, New York Agric. Exper. Station, 1902.)

—— A study of some of the salts formed by casein and paracasein with acids; their relations to American cheddar cheese. (*Being* Bull. No. 214, New York Agric. Exper. Station, 1902.)

—— The relation of carbon dioxide to proteolysis in the ripening of cheddar cheese. (*Being* Bull. No. 231, New York Agric. Exper. Station, 1903.)

Vaubel, Wilhelm. Lehrbuch der theoretischen Chemie. Vol. I. Materie und Energie—Molekül und Lösung. Vol. II. Zustandsänderungen und chemische Umsetzungen. pp. 736 + 793. ill. Berlin 1903.

Vines, S. H. Proteolytic enzymes in plants. (From the *Annals of Botany*, XVII, 1903.)

Violette, J. H. M., and Archambault, P. J. Dictionnaire des analyses chimiques, ou répertoire alphabétique des analyses de tous les corps naturels et artificiels depuis l'origine de la chimie jusqu'a nos jours, avec l'indication du nom des auteurs et des recueils ou elles ont été insérées. 2 vols. Paris 1851.

Voelcker, J. A., and Hall, A. D. The valuation of unexhausted manures obtained by the consumption of foods by stock. (From the *Journ. Royal Agric. Soc. Eng.*, 63.)

Vogl, August Emil. Die wichtigsten vegetabilischen Nahrungs- und Genussmittel, mit besonderer Berücksichtigung der mikroskopischen Untersuchung auf ihre Echtheit, ihre Verunreinigungen und Verfälschungen. pp. xv + 575. ill. Berlin 1899.

Walker, A. J. *See* Holleman, A. F.

Walker, T. A. *See* Rideal, S.

Weber, Carl Otto. The chemistry of india-rubber, including the outlines of a theory of vulcanisation. pp. viii + 314. ill. London 1902.

Weber, H. *See* Gauss, C. F.

Weber, R. H. *See* Gauss, C. F.

Weinberg, Boris. L'enseignement pratique de la physique dans 206 laboratoires de l'Europe, de l'Amerique, et de l'Australie. Odessa 1902.

Wells, Henry M. Cylinder oil and cylinder lubrication. Part I. (From the *Engineer*, *July* 17 and 31, *August* 7 and 14, 1903.)

Weltzien, Karl, and Lang, H. Das chemische Laboratorium an der grossherzogl. polytechnischen Schule zu Carlsruhe. ill. Carlsruhe 1853.

Whetham, William Cecil Dampier. A treatise on the theory of solution, including the phenomena of electrolysis. pp. 488. ill. Cambridge 1902.

White, H. G. *See* Stocks, H. B.

Wiener, Ferdinand. Die Weissgerberei, Sämischgerberei und Pergament-Fabrikation. pp. 371. ill. Wien 1904.

Wiley, H. W. Manufacture of table syrups from sugar cane. (*Being* U.S. Dept. of Agric. Bureau of Chemistry, Bull. No. 53.)

Winteler, F. Die Aluminium-Industrie. pp. 108. ill. Braunschweig 1903.

Wohltmann, F. Chilisalpeter oder Ammoniak? pp. 50. Berlin 1903.

Wolfrum, A. Chemisches Praktikum. Teil II. Präparative und fabrikatorische Uebungen. pp. 575. Mit einem Atlas. Leipzig 1903.

Wolfrum, A. Die Grundzüge der chemischen Didaktik. Eine Studie über das Studium Chemie und den Laboratoriumsunterricht. pp. 147. Leipzig 1903.

Wright, Charles Romley Alder. Animal and vegetable fixed oils, fats, butters, and waxes: their preparation and properties, and the manufacture therefrom of candles, soaps, and other products. 2nd edition, edited and partly rewritten by C. Ainsworth Mitchell. pp. xvi + 804. ill. London 1903.

Zellner, Julius. Die künstlichen Kohlen für elektrotechnische und elektrochemische Zwecke, ihre Herstellung und Prüfung. pp. 295. ill. Berlin 1903.

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R. CLAY AND SONS, LTD., BREAD ST. HILL, E.C., AND BUNGAY, SUFFOLK.

Issued 29/1/03

PROCEEDINGS

OF THE

CHEMICAL SOCIETY.

Vol. 19. No. 259.

Wednesday, January 21st, 1903. Professor J. EMERSON REYNOLDS, Sc.D., F.R.S., President, in the Chair.

Mr. W. H. Edwards was formally admitted a Fellow of the Society.

Certificates were read for the first time in favour of Messrs.:

George Henry Appleyard, 151, Cleveland Street, Hull.
Samuel Bradbury, Thornham New Road, Castleton.
George Thomas Branch, Claremont, Cape Town, S. Africa.
Hubert William Bywaters, 11, King Street, Regent Street, W.
William Henry Cadman, Lord Williams's Grammar School, Thame.
John Castell-Evans, 141, Ferme Park Road, Crouch End, N.
Arthur John Codling, 5, Tavistock Square, W.C.
Benjamin Claxton Coyle, 65, Lansdowne Road, Dublin.
Cecil Henry Desch, Instow, Mount Pleasant Road, Tottenham, N.

Leonard King Hindmarsh, 354, Lordship Lane, S.E.
Franklin Wise Howorth, Rose Bank, Elmdale Road, Palmers Green, N.
Arthur Graham Leigh, Chorcliff House, Chorley.
Percy George Mander, Spon House, Spon End, Coventry.
Frederick O'Brien, 15, Lilymead Avenue, Knowle, Bristol.
Alec Bowring Steven, Ness House, Surbiton.
George Malcolm Thomson, Newington, Dunedin, N.Z.
Stanley Tolson, 14, Furnivall Road, Balby, Doncaster.
Francis Digby Toyne, Santubong, Sarawak.
Thomas Crosbie Walsh, "Sunnyside," Muswell Avenue, Muswell Hill, N.
David John Williams, 1, St. Agnes Place, Kennington Park, S.E.

The Secretary announced that a communication had been received from Profs. Börnstein and Meyerhoffer stating that they were engaged in revising the *Physikalisch-chemische Tabellen* of Landolt and Börnstein, and would welcome from English chemists any suggestions of alterations or corrections for the new edition, addressed to them, "care of Verlag von Julius Springer, Berlin, N."

The Council has ordered the following report to be printed in the Journal and in the Proceedings of the Society:

Report of the International Committee on Atomic Weights.

In the year 1900, an International Committee on atomic weights was organised, composed of more than fifty representatives from chemical and other societies. Its conferences were necessarily conducted by correspondence, and the delays and difficulties of the work proved to be both serious and annoying. Accordingly, the Committee, by vote, designated a smaller body of three representatives, and the latter now has the honour to report its recommendations.

On the fundamental question of standards, definite and formal action seems to be impracticable. By the original committee of the German Chemical Society, the oxygen standard was adopted, but that proposal, whilst receiving strong support, also met with serious opposition. In fact, opinion as expressed by individual voices seems to be somewhat evenly divided upon this question, and around it there has already grown up a controversial literature of formidable proportions. To force the adoption of either standard, oxygen, or hydrogen, appears therefore to be impossible, and for some time to come both are likely to be employed. Between them, experience

must be the final arbiter. That standard which best serves to co-ordinate chemical and physical knowledge will ultimately be chosen, and the other will gradually fall into disuse. Meanwhile, it is important that the most probable values for the several atomic weights should be indicated, and that every table of them should be consistent within itself. Such a table has been prepared by our distinguished predecessors and its revision, as knowledge advances, seems to be our proper function.

In order that our work may be of the most general service, we have prepared a table in which both standards of atomic weight are represented. In most of its details it is identical with the table which was reported by the previous committee at the beginning of the year 1902.* Some changes, however, have, in our judgment, become necessary, and these may be briefly indicated as follows:

Antimony.—In the former reports of the committee, the value derived by Cooke from analyses of the bromide, Sb = 120, was adopted. This, however, ignores the work of Cooke and of Schneider upon antimony trisulphide, and the still more recent determinations made by Friend and Smith. The true number being therefore in doubt, we recommend the use of an average value, and put Sb = 120·2.†

Germanium.—The number 72·5 is more nearly in accord with Winkler's determinations than the former number 72.

Hydrogen.—In the column which represents the oxygen standard, hydrogen has heretofore been assigned the value 1·01. The number 1·008 is, however, much more exact, and the error in 1·01 is too large to be perpetuated. Each figure should be given to the nearest *significant* decimal.

Lanthanum.—During 1902, two new determinations of the atomic weight of lanthanum were published. According to Jones, La = 138·77. Brauner and Pavlíček found La = 139·04. Both investigations were conducted with great skill and care, and each one seems to have some points of advantage over the other. The average, La = 138·9, appears to be the safest value to adopt. These data naturally influence our judgment in the case of cerium, and we retain Brauner's number, Ce = 140, rather than adopt the lower estimates made by other observers.

Mercury.—Taking into account all the determinations which have appeared, and giving great weight to the most recent measurements by Hardin, we regard the value Hg = 200 as best warranted by the existing evidence.

* In No. 1 of the *Berichte* for 1902.

† O = 16.

Palladium.—The atomic weight of this metal is in doubt. The best determinations give values ranging from 106 to 107. The mean between them, Pd = 106·5, has been provisionally adopted.

Radium.—This element appears in the table for the first time. Madame Curie's determination of the atomic weight, Ra = 225, is probably not far from the truth.

Selenium.—Judging from the work of Lenher, and the very recent determinations by Jul. Meyer, the former value, Se = 79·1, is probably too low. In order to give due weight to the newer measurements, we write Se = 79·2.

Tin.—The determinations by Bongartz and Classen, which seem to be the best, make Sn = 119. The former value, 118·5, is almost certainly too low.

Uranium.—According to the very recent investigation by Richards and Merigold, the atomic weight of uranium is 238·5.

Zirconium.—The figure Zr = 90·6 is apparently the most probable.

In thus assuming the duties assigned to us by the larger International Committee, we act upon the conviction that the purpose of our appointment is to secure the promptness and efficiency which is only possible with a comparatively small working body. In order to carry out this purpose, we must depend upon the co-operation and assistance of our colleagues. We therefore beg that they, and also all other chemists who are interested in researches upon atomic weights, will aid us with their criticisms and advice. We especially ask that publications upon the subject shall be sent to us, in triplicate if possible, so that no matter of importance may be overlooked. Without support of this kind our work cannot be made fully effective.

The complete table of atomic weights, with foregoing changes incorporated, follows.

F. W. Clarke
T. E. Thorpe } *Committee.*
Karl Seubert

1903.

International Atomic Weights.

		O=16.	H=1.
Aluminium	Al	27·1	26·9
Antimony	Sb	120·2	119·3
Argon	A	39·9	39·6
Arsenic	As	75·0	74·4
Barium	Ba	137·4	136·4
Bismuth	Bi	208·5	206·9
Boron	B	11	10·9
Bromine	Br	79·96	79·36
Cadmium	Cd	112·4	111·6
Cæsium	Cs	133	132
Calcium	Ca	40·1	39·8
Carbon	C	12·00	11·91
Cerium	Ce	140	139
Chlorine	Cl	35·45	35·18
Chromium	Cr	52·1	51·7
Cobalt	Co	59·0	58·56
Columbium (Niobium)	Cb	94	93·3
Copper	Cu	63·6	63·1
Erbium	E	166	164·8
Fluorine	F	19	18·9
Gadolinium	Gd	156	155
Gallium	Ga	70	69·5
Germanium	Ge	72·5	71·9
Glucinum (Beryllium)	Gl	9·1	9·03
Gold	Au	197·2	195·7
Helium	He	4	4
Hydrogen	H	1·008	1·000
Indium	In	114	113·1
Iodine	I	126·85	125·90
Iridium	Ir	193·0	191·5
Iron	Fe	55·9	55·5
Krypton	Kr	81·8	81·2
Lanthanum	La	138·9	137·9
Lead	Pb	206·9	205·35
Lithium	Li	7·03	6·98
Magnesium	Mg	24·36	24·18
Manganese	Mn	55·0	54·6
Mercury	Hg	200·0	198·5
Molybdenum	Mo	96·0	95·3
Neodymium	Nd	143·6	142·5
Neon	Ne	20	19·9
Nickel	Ni	58·7	58·3
Nitrogen	N	14·04	13·93
Osmium	Os	191	189·6
Oxygen	O	16·00	15·88
Palladium	Pd	106·5	105·7
Phosphorus	P	31·0	30·77
Platinum	Pt	194·8	193·3
Potassium	K	39·15	38·86
Praseodymium	Pr	140·5	139·4
Radium	Ra	225	223·3
Rhodium	Rh	103·0	102·2
Rubidium	Rb	85·4	84·8
Ruthenium	Ru	101·7	100·9
Samarium	Sm	150	148·9
Scandium	Sc	44·1	43·8
Selenium	Se	79·2	78·6
Silicon	Si	28·4	28·2
Silver	Ag	107·93	107·12
Sodium	Na	23·05	22·88
Strontium	Sr	87·6	86·94
Sulphur	S	32·06	31·83
Tantalum	Ta	183	181·6
Tellurium	Te	127·6	126·6
Terbium	Tb	160	158·8
Thallium	Tl	204·1	202·6
Thorium	Th	232·5	230·8
Thulium	Tm	171	169·7
Tin	Sn	119·0	118·1
Titanium	Ti	48·1	47·7
Tungsten	W	184·0	182·6
Uranium	U	238·5	236·7
Vanadium	V	51·2	50·8
Xenon	X	128	127
Ytterbium	Yb	173·0	171·7
Yttrium	Yt	89·0	88·3
Zinc	Zn	65·4	64·9
Zirconium	Zr	90·6	89·9

Of the following papers, those marked * were read:

*1. "Researches on silicon compounds. Part VIII. Interactions of silicophenylamide with thiocarbimides." By J. Emerson Reynolds.

The author has shown that the fine, crystalline silicophenylamide, $Si(NHC_6H_5)_4$, described in part V of this series of papers, loses aniline on careful heating and affords, first, silicotriphenylguanidine and, subsequently, silicodiphenylimide (*Trans.*, 1900, 77, 836).

The comparative ease and completeness with which the change $Si(NHPh)_4 = Si(NPh)_2 + 2NH_2Ph$ can be realised suggested another mode of producing the di-imide, involving the action of thiocarbimides. It was anticipated that silicophenylamide would react in the following manner: $Si(NHPh)_4 + 2R'N{:}CS = Si(NPh)_2 + 2CSN_2H_2PhR'$.

Whilst the above change can be realised, the author showed that the marked tendency of silicon to form complex molecules lead to other and unexpected interactions with thiocarbimides, and found that:

1. Silicophenylamide in benzene solution is not decomposed by a thiocarbimide, even at the boiling point of the solvent, but addition compounds are formed. For example, ethyl thiocarbimide in excess gives fine, needle-like crystals consisting of $Si(NHPh)_4,2EtNCS$, and, when not in excess, rhombic plates of $Si(NHPh)_4,EtNCS$. Both compounds lose the whole of the thiocarbimide at 100° and leave silicophenylamide unchanged.

2. A very different result is obtained when one molecule of silicophenylamide and two molecules of a thiocarbimide, without a solvent, are heated in sealed tubes at 160°. At first, the two compounds unite directly as before, but when the temperature rises to 140° a thick, slightly brown liquid begins to form, the production of which is complete on heating to 160° for half an hour. At the ordinary temperature, this substance is a very viscid liquid, and a specimen of the ethyl compound has been kept for several months without separation of any crystals. Methyl, ethyl and phenyl thiocarbimides afford similar products, which have no odour of thiocarbimide, even when strongly heated; they are easily miscible with benzene, from which they are precipitated on addition of ligroin, and may thus be purified by a repetition of this treatment. Prolonged digestion of the benzene solution of each substance leads to a slow separation of silicodiphenylimide, whilst the liquid affords crystals of a disubstituted thiocarbamide. Therefore the interaction anticipated actually does take place

at a sufficiently high temperature, but the resulting silicon di-imide and thiocarbamide unite to form a homogeneous liquid consisting of $Si(NPh)_2,2CSN_2H_2PhR'$, which is slowly dissociated in boiling benzene.

3. Silicophenylamide also interacts with 4 molecules of thiocarbimides at 160°, but not with more than 4 molecules. The products are also viscid liquids at first, but they are not homogeneous, as crystals form to a relatively small extent in the mass on standing for some time, and are those of a substituted thiocarbamide. The liquid portion consists, in each case, of a new substance resulting from the action of the two additional molecules of thiocarbimide on the silicon di-imide produced in the first interaction. These liquids are miscible with benzene, but do not dissociate in it; they are decomposed by alcohol and afford ethyl orthosilicate, alkyl dithiocarbamate, and a guanidine derivative, hence their constitution is probably $\begin{matrix}PhN\\PhN\end{matrix}\!\!>\!Si\!<\!\!\begin{matrix}CS\cdot NR'\\CS\cdot NR''\end{matrix}$.

Silicodiphenylimide, produced by heat from silicophenylamide, combines directly with thiocarbimides to form compounds of this type.

***2. "On the relation between the absorption spectra and the chemical structure of corydaline, berberine, and other alkaloids." By J. J. Dobbie and A. Lauder.**

It has been proved by purely chemical investigations that corydaline and berberine are closely related to one another and that both alkaloids are constructed on the same general plan as papaverine, narcotine, hydrastine, and narceine.

An examination of the absorption spectra of the members of this group of alkaloids shows that those which are most closely related structurally give similar spectra, the differences in the spectra becoming more pronounced as the structural differences increase in importance. Thus corydaline and tetrahydroberberine closely resemble each other in structure, and the spectra of the latter only differ from those of the former in the somewhat greater general absorption which they exhibit. Narcotine only differs from hydrastine in containing an additional methoxyl group, and their spectra are almost identical, but quite distinct from those of corydaline, from which both differ considerably in structure. Papaverine and narceine are constitutionally still further removed from corydaline, and their spectra show a correspondingly increased difference as compared with those of the other members of the group. When papaverine, however, is reduced to tetrahydropapaverine, its constitution then corresponds

much more closely with that of corydaline, and the spectra of the reduced compound are similar to those of corydaline.

When the corresponding derivatives of corydaline and tetrahydroberberine are compared, it is seen that the latter only differ from the former in possessing a slightly greater absorptive power. Since the only structural difference between the two series of derivatives consists in the replacement of two of the methoxyl radicles of corydaline by the dioxymethylene group in berberine, it was inferred that the difference in the amount of general absorption must be due to this difference of structure and that the dioxymethylene complex must consequently exert a more powerful absorption than two methoxyl groups. The correctness of this inference received support from the direct comparison of the spectra of piperonylic acid, $C_6H_3(O_2CH_2)CO_2H$, with those of veratric acid, $C_6H_3(OMe)_2 \cdot CO_2H$.

Whilst the spectra of ω-aminoethylpiperonylcarboxylic anhydride, $C_9H_7NO(O_2CH_2)$, from berberine, and of corydaldine, $C_9H_7NO(OMe)_2$, from corydaline are very similar, they differ widely from those of cotarnine and hydrastinine, the corresponding oxidation products of narcotine and hydrastine respectively. This difference finds a sufficient explanation in the fact that the pyridine ring, which is closed in corydaldine and ω-aminoethylpiperonylcarboxylic anhydride, is open in cotarnine and hydrastinine. The action of potassium hydroxide converts hydrastinine into oxyhydrastinine, in which the pyridine ring is closed. The spectra of oxyhydrastinine, and corydaldine are almost identical.

Hartley (*Phil. Trans.*, 1885, Pt. II., 471) has already shown that many of the alkaloids give highly characteristic spectra and has pointed out the applicability of the method to the study of their constitution. The authors draw certain general conclusions as to the relation between the structure and the absorption spectra of the alkaloids. These conclusions are based chiefly on the results of the examination of the alkaloids of the corydaline group, but are supported by the results of the examination of other alkaloids.

Alkaloids which differ essentially in structure, even when their molecular formulæ are the same, give dissimilar spectra, whilst alkaloids which are closely related structurally give similar spectra, and sometimes, when the structural resemblance is very close, spectra which are indistinguishable from one another.

Stereoisomeric alkaloids give identical spectra. In the examination of stereoisomeric phenomena, the spectroscope affords a means of determining whether two substances of the same formula, the one active and the other inactive, are related to one another as stereoisomerides. If they give different spectra, it can be inferred with great certainty that they differ structurally.

Homologous alkaloids give practically the same spectra. The formula of bulbocapnine differs from that of tetrahydroberberine and papaverine only by CH_2, but the wide difference between the spectra of all three substances precludes the possibility that bulbocapnine is homologously related to either. Whilst important differences of structure are always accompanied by marked differences in the spectra, many of the structural details of an alkaloid may be modified without any appreciable effect being produced in the spectra. An example of this is afforded by the replacement of two of the methoxyl groups of corydaline by the dioxymethylene group in berberine. When, therefore, two alkaloids give spectra which are nearly, but not quite, identical, it may be inferred with considerable probability that they differ only in minor details of structure. In such cases, a preliminary spectroscopic examination would sometimes give a clue to the constitution of an alkaloid which would greatly facilitate the chemical investigation.

***3. "The absorption spectra of laudanine and laudanosine in relation to their chemical constitution." By J. J. Dobbie and A. Lauder.**

In this paper, the absorption spectra of laudanine, $C_{20}H_{25}O_4N$, and laudanosine, $C_{21}H_{27}O_4N$, two rare opium alkaloids discovered by Hesse, are described. They are shown to be practically identical with one another and, further, to resemble very closely the spectra of corydaline and tetrahydropapaverine (see preceding abstract). The close resemblance between the spectra of laudanine and laudanosine confirms the view that they are homologous bodies, whilst the close agreement with the spectra of corydaline and tetrahydropapaverine points to the possession of a structure similar to that of these alkaloids.

For reasons given below, the relationship with corydaline is probably somewhat closer than with tetrahydropapaverine. Laudanosine has one atom of carbon less than corydaline, the number of hydrogen, oxygen, and nitrogen atoms being the same in both. Assuming the formulæ of the two alkaloids to have been correctly determined, the difference between them may conceivably consist in the absence from laudanosine of the methyl group which is present in corydaline and in the partial reduction of one of its rings,

$$\underset{\text{Corydaline.}}{C_{22}H_{27}O_4N} - CH_2 + H_2 = \underset{\text{Laudanosine.}}{C_{21}H_{27}O_4N}.$$

In this way, the close agreement of the spectra might be accounted for. The absence of the methyl group would produce no appreciable

effect, and it is known from the examination of a number of cases that the introduction of two atoms of hydrogen into a molecule is not necessarily accompanied by any notable modification of its spectra. The spectroscopic evidence as to the close relationship subsisting between laudanosine and corydaline is substantiated by the little which is known concerning the chemistry of the former alkaloid. Like corydaline, it contains four methoxyl groups and yields metahemipinic acid as one of its oxidation products. It further resembles corydaline in the ease with which it is oxidised by nitric acid to a yellow base. This basic product has not been analysed, but it is not improbably identical with meconidine, an alkaloid associated with laudanosine in opium. The formula of meconidine is $C_{21}H_{23}O_4N$ and bears the same relationship to that of laudanosine that the formulæ of dehydrocorydaline and berberine respectively bear to those of corydaline and tetrahydroberberine.

Colourless:

Corydaline.	Tetrahydroberberine.	Laudanosine.
$C_{22}H_{27}O_4N$.	$C_{20}H_{21}O_4N$.	$C_{21}H_{27}O_4N$.
M. p. 135·5°.	M. p. 167°.	M. p. 89°.

Yellow:

Dehydrocorydaline.	Berberine.	Meconidine.
$C_{22}H_{23}O_4N$.	$C_{20}H_{17}O_4N$.	$C_{21}H_{23}O_4N$.
M. p. 118—120°.	M. p. 145°.	M. p. 58°.

Whether the yellow substance produced by the oxidation of laudanosine is identical with meconidine or not, the mere fact of the existence in opium of the coloured base having a formula differing from that of laudanosine by four atoms of hydrogen affords support to this view of the relationship of these substances, and this hypothesis receives additional confirmation from a comparison of the melting points of the substances.

Discussion.

Dr. Jowett asked if the authors had tried the method with stereoisomeric alkaloids like atropine and hyoscyamine or the scopolamines, or whether the method had been confined to those alkaloids with a quinoline or *iso*quinoline nucleus. If the method was of general application, it would prove of great service in distinguishing between stereoisomerides and isomeric alkaloids differing structurally.

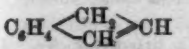
Professor Dunstan remarked that Dr. Dobbie had made a distinct step in advance in the direction of showing how these absorption spectra, for a knowledge of which chemists owe so much to Professor

Hartley, may be definitely utilised as a criterion in determining the general molecular structure of alkaloids. Though possibly of limited application, the method promised to be of value in dealing with cases, such as those now brought forward by Professor Dobbie, where chemical methods were not yet available or applicable.

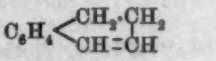
Professor DOBBIE, in reply, said that although he and Mr. Lauder had incidentally examined some of the pyridine alkaloids, they had not made any systematic study of them, as they had of the alkaloids of high molecular weight.

4. "Phenocycloheptene." By F. S. Kipping and A. E. Hunter.

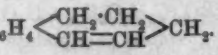
The dry hydrochloride of pheno-*o*-aminocycloheptane (Kipping and Hunter, *Trans.*, 1901, **79**, 602) undergoes decomposition at about 240°, giving ammonium chloride and phenocycloheptene, a homologue of indene and of dihydronaphthalene:



Phenocyclopentene. (Indene.)



Phenocyclohexene. (Dihydronaphthalene.)



Phenocycloheptene.

Phenocycloheptene, $C_{11}H_{12}$, a colourless liquid having an odour which recalls that of indene, boils at 233·5—234° (757 mm.) and has a sp. gr. 1·009 at 4°/4°. It differs from indene in chemical properties as it neither gives a picrate nor a condensation product with benzaldehyde in presence of sodium ethoxide.

On oxidation with potassium permanganate in alkaline solution at the ordinary temperature, phenocycloheptene is converted into an acid identical with the phenylbutyric-*o*-carboxylic acid, $CO_2H{\cdot}C_6H_4{\cdot}[CH_2]_3{\cdot}CO_2H$, prepared synthetically by Roser (*Ber.*, 1885, **18**, 3118); this acid seems to be dimorphous as, when first produced, it crystallises in needles melting at 122° and subsequently in plates melting at 138°, the latter being the form obtained by Roser, but the conditions which determine the formation of the one or other modification could not be ascertained. On oxidation with hot, very dilute nitric acid, the unsaturated hydrocarbon gives the form melting at 138°.

5. "The influence of molybdenum and tungsten trioxides on the specific rotations of *l*-lactic acid and potassium *l*-lactate." By G. G. Henderson and J. Prentice.

Both molybdenum trioxide and tungsten trioxide are dissolved by a hot aqueous solution of potassium *l*-lactate, the former readily, but the latter with greater difficulty. In each case, the specific rotation increases with the quantity of oxide in solution and reaches a maximum ($[\alpha]_D^{20°} = +22{\cdot}69°$ and $+10{\cdot}8°$ respectively) when the substances are present in the proportion of 2 molecules of $C_3H_5O_3K$ to 1 molecule of RO_3. At this point, the solutions are practically saturated with the oxides, for, although a little more of each oxide can be dissolved in the heat, decomposition then ensues, and the solutions become coloured blue or brown according as molybdenum or tungsten trioxide is used. These results point to the formation of potassium molybdilactate and tungstilactate according to the equation: $2C_3H_5O_3K + RO_3 = RO_2(C_3H_4O_3K)_2 + H_2O$.

Sodium molybdate and tungstate are readily dissolved by an aqueous solution of *l*-lactic acid, the specific rotation increasing in each case as larger quantities of the salt are added. The highest readings ($[\alpha]_D^{20°} = +21{\cdot}15°$ and $+9{\cdot}9°$) are obtained when the solutions contain 1 molecule of Na_2RO_4 for each 2 molecules of $C_3H_6O_3$, and if a larger quantity of either salt is added the rotation diminishes. It seems, therefore, that a reaction occurs in the sense of the equation $2C_3H_6O_3 + Na_2RO_4 = RO_2(C_3H_4O_3Na)_2 + 2H_2O$, sodium molybdilactate and tungstilactate being formed.

Molybdenum trioxide is also dissolved by an aqueous solution of *l*-lactic acid, but the compound formed in the solution is decomposed by exposure to heat or even to diffused daylight, and hence the process of dissolution must be carried on in the cold and in a dark place. The specific rotation increases as the oxide is added and reaches a maximum ($[\alpha]_D^{20°} = +24{\cdot}78°$) when 1 molecule of MoO_3 is present for each 1 molecule of $C_3H_6O_3$, diminishing again on the addition of more oxide. This result indicates the formation of a compound $CHMe(CO_2H)O{\cdot}MoO_2{\cdot}OH$, or more probably $CHMe\langle\begin{smallmatrix}O\\CO_2\end{smallmatrix}\rangle MoO_2$. The sensibility to light of the solution is so great that a good print from a negative can be taken on paper saturated with the solution and dried in the dark, but the blue colour of the print fades away in the absence of light.

Tungsten trioxide was found to be practically insoluble in an aqueous solution of *l*-lactic acid.

According to the views formerly expressed (*Trans.*, 1899, 75, 542)

regarding the constitution of the "tartar emetic" class of compounds, molybdenum and tungsten trioxides should react with lactates, yielding derivatives of the type $RO_2(O{\cdot}CHMe{\cdot}CO_2M)_2$, and the results of this investigation point to the formation of compounds having this composition.

6. "Estimation of ethyl alcohol in essences and medicinal preparations." By T. E. Thorpe and John Holmes.

The authors described a method of estimating ordinary alcohol in essences and medicinal preparations containing essential oils and volatile substances, such as ether, chloroform, benzaldehyde, camphor, compound ethers, and which has been used for some time past in the Government Laboratory and which has been found to be both accurate and of very general applicability.

It is as follows: 25 c.c. of the sample, measured at 15·5°, are mixed with water in a separator to a bulk of from 100 to 150 c.c., and common salt is added in sufficient quantity to saturate the liquid. The mixture is now shaken vigorously for 5 minutes with from 50 to 80 c.c. of light petroleum boiling below 60°, and after standing for about half an hour the lower layer is drawn off into another separator, extracted, if necessary, a second time with petroleum, and then introduced into a distillation flask. Meanwhile, the petroleum layers are washed successively with 25 c.c. of saturated brine, the washings added to the main bulk, which is neutralised if necessary, and then distilled, and the distillate made up to 100 c.c. and its relative density determined at the standard temperature in the usual manner. The results thus obtained require a small correction from the circumstance that, as the alcohol present is distilled into four times its initial volume, the errors of the spirit tables are necessarily quadrupled. Details were given of the mode in which the magnitude of this error may be determined, and from these results the mean error of the tables at below 40 per cent. proof (for example, 0·972 sp. gr.), which is the particular section of tables mainly used, may be set down as +0·2 per cent. of proof spirit, and hence the observed determinations, expressed as percentages of proof spirit, require a subtractive correction of 0·8 per cent.

Tables were given of results obtained on preparations actually made in the laboratory and containing known quantities of ethyl alcohol as evidence of the accuracy and general applicability of the method and of the degree of variation which may be expected to occur between the results of different operators.

7. "Carbon monoxide as a product of combustion of the Bunsen burner." By T. E. Thorpe.

The author, in the course of an inquiry into the nature of the combustion-products of certain of the gas- and oil-stoves in common use, has had occasion to make observations on the behaviour of the Bunsen burner as regards its liability to evolve carbon monoxide when burning under an ordinary laboratory sand-tray. He finds that a burner fed with coal-gas at the rate of 6 cubic feet per hour and under 0·95 inch pressure will evolve about 0·022 cubic foot of carbon monoxide when burnt under a sand-tray in such manner that the inner cone of the flame impinges, or apparently impinges, on the metal.

8. "Derivatives of β-resorcylic acid and of protocatechuic acid." By W. H. Perkin, junr., and E. Schiess.

The authors have been engaged for some time in the investigation of some derivatives of these acids, and the appearance of a paper by Bülow and Riess (*Ber.*, 1902, 35, 3900), which deals with somewhat similar derivatives obtained from α-resorcylic acid, has necessitated the publication of the following short account of their results.

Methyl dimethyl-β-resorcylate, $(OMe)_2C_6H_3{\cdot}CO_2Me$, is readily obtained as a colourless oil boiling at 160—162° under 13 mm. pressure when β-resorcylic acid is treated with potassium hydroxide and methyl sulphate in aqueous solution. The corresponding ethyl dimethyl-β-resorcylate boils at 170° under 13 mm. pressure.

2 : 4-*Dimethoxybenzoylacetophenone*, $(OMe)_2C_6H_3{\cdot}CO{\cdot}CH_2{\cdot}COPh$, is produced when sodium acts on a mixture of ethyl dimethylresorcylate and acetophenone dissolved in dry ether; it crystallises in plates, melts at 55°, and develops a brownish-red coloration with alcoholic ferric chloride. The ethereal solution gives, with copper acetate, the copper compound $C_{34}H_{30}O_8Cu$, which crystallises from benzene in slender, green needles containing one molecule of benzene.

2 : 4-*Dimethoxycinnamic acid*, $(OMe)_2C_6H_3{\cdot}CH{:}CH{\cdot}CO_2H$, which has already been obtained from methylumbelliferone by Will and Tiemann (*Ber.*, 1882, 15, 2080; 1883, 16, 2116) in two modifications (α- and β-) melting respectively at 138° and 184°, may be easily prepared synthetically by digesting dimethylresorcylaldehyde (2 : 4-dimethoxybenzaldehyde), $(OMe)_2C_6H_3{\cdot}CHO$, with sodium acetate and acetic anhydride in the usual manner. The acid obtained in this way by the authors was the β-modification melting at 184°.

The *ethyl* salt, $(OMe)_2C_6H_2\cdot CH{:}CH\cdot CO_2Et$, is very conveniently prepared, in a yield of 80 per cent., by treating a mixture of dimethylresorcylaldehyde and ethyl acetate with sodium (compare Claisen, *Ber.*, 1890, **23**, 977); it is a colourless oil distilling at 208° under 13 mm. pressure.

3 : 4-*Dimethoxycinnamic acid* may be obtained by treating dimethylcatecholaldehyde (3 : 4-dimethoxybenzaldehyde) in a similar manner; it crystallises from acetic acid in needles, melts at 180°, and is identical with the acid which Tiemann and Will (*Ber.*, 1881, **14**, 960) first prepared from caffeic and ferulic acids by treatment with potassium hydroxide and methyl iodide. Its *ethyl* salt may be prepared from the acid by esterification in the usual manner, but much more conveniently by acting on a mixture of dimethylcatecholaldehyde and ethyl acetate with sodium. It crystallises from light petroleum in plates, melts at 59°, and distils at 196—197° under a pressure of 11 mm.

Ethyl 3 : 4-*dimethoxyphenyl-α* : *β-dibromopropionate*, $(OMe)_2C_6H_2\cdot CHBr\cdot CHBr\cdot CO_2Et$, which is formed when the last-mentioned ethyl salt is treated with bromine in chloroform solution, melts at 111°, and, when hydrolysed with excess of alcoholic potash, is converted into 3 : 4-*dimethoxyphenylpropiolic acid*, $(OMe)_2C_6H_2\cdot C{:}C\cdot CO_2H$, a colourless, crystalline substance melting at 149°. A detailed investigation of the above substances and their derivatives is in progress.

9. "Synthesis of imino-ethers. *N*-Ethyl-, *N*-methyl-, and *N*-benzylbenziminoethers." By G. D. Lander.

Alkylation by means of silver oxide and alkyl iodides occurs to a very limited extent with the alkyl and benzyl benzamides, and the imino-ethers were therefore prepared from the imide chlorides by means of the sodium alkyloxides (*Trans.*, 1902, **81**, 591). The *N*-ethyl and *N*-methyl derivatives are contaminated with compounds of higher boiling points containing a smaller percentage of carbon, which may be ortho-compounds of the type $CPh(OR)_2NHR'$. The purification of the imino-ethers is effected by warming with 1/10 molecule of acetic anhydride.

The *imide chloride* of *benzethylamide*, $CPhCl{:}NEt$, boils at 110—111° (15 mm.) and gives, on treatment with aniline, *ethylphenylbenzenylamidine*, $CPh(:NEt)\cdot NHPh$; this base, which melts at 74—76°, is also obtained by condensing aniline with the imino-ether; its platinichloride crystallises with $2H_2O$ and melts at 204°.

N-Ethylbenziminc-ethyl ether, CPh(OEt):NEt, and *N-ethylbenziminomethyl ether*, CPh(OMe):NEt, boil at 105° and 97—100° under 11 mm. pressure, and at 221—223° and 209—212° (uncorr.) under the ordinary pressure, respectively; they are colourless, limpid liquids of amine-like odour.

Benzoyldiethylbenzenylamidine, CPh(:NEt)·NEt·COPh, a basic bye-product of the imino-ether synthesis, crystallises in colourless prisms melting at 90—91·5° without decomposition; its *platinichloride* melts at 151—151·5°, and its solution, in dilute hydrochloric acid, gradually decomposes with the formation of benzoic acid, ethylamine, and a compound (m. p. 101—102°) not yet examined.

N-Methylbenziminomethyl ether, CPh(OMe):NMe, boils at 94—95° under 12 mm., and at 203—206° (uncorr.) under the ordinary pressure; the crude hydrochloride melts at 65—70°, regenerating benzmethylamide.

N-Methylbenziminoethyl ether, CPh(OEt):NMe, was not obtained pure; it boils at about 105° under 14 mm., and at about 215° under the ordinary pressure.

Benzoyldimethylbenzenylamidine, CPh(:NMe)·NMe·COPh, which resembles the diethyl compound in crystalline form and properties, melts at 116—117·5°, its *platinichloride* melts at 184—185°.

The *imide chloride of benzbenzylamide*, $CPhCl{:}NCH_2Ph$ (compare *Ber.*, 1897, 30, 1788), decomposes, almost completely, on distillation into benzonitrile and benzylchloride, but the undistilled imide chloride condenses with aniline yielding *phenylbenzylbenzenylamidine*, $CPh(:NCH_2Ph)\cdot NHPh$, which melts at 99—100°, and is identical with Beckmann and Fellrath's base obtained from benzphenylamide imide chloride and benzylamine, and also with the amidine formed by condensation of *N*-benzylbenzimino-ethyl ether with aniline. *Phenylmethylbenzylbenzenylamidine*, $CPh(:NCH_2Ph)\cdot NMePh$, which is produced either from methylaniline and the imide chloride of benzbenzylamide, or by alkylating the above described amidine with methyl iodide, melts at 89—90°.

N-Benzylbenzimino-ethyl ether, $CPh(OEt){:}NCH_2Ph$, is a viscid, colourless, odourless oil, boiling at 186—188° under 12 mm. pressure; the corresponding *methyl ether*, $CPh(OMe){:}NCH_2Ph$, boils at 178—180° under 11 mm. pressure. These *N*-benzylbenzimino-ethers, when left in contact with air, undergo oxidation to dibenzamide.

10. "The condensation of phenyl ethyl ketone (propiophenone) with benzalacetophenone and of acetophenone with benzalpropiophenone." By R. D. Abell.

Phenyl ethyl ketone and benzalacetophenone condense under the influence of sodium ethoxide to form: (i) 2-phenyl-1-methyl-1 : 3-dibenzoylpropane, $C_{24}H_{22}O_2$ (prisms, m. p. 103·5—104·5°); (ii) 2 : 4-diphenyl-1-methyl-1 : 3 : 5-tribenzoylpentane, $C_{39}H_{34}O_3$ (rhombic plates, m. p. 241—242°).

The former substance reacts with hydroxylamine to form a *dioxime*, $C_{24}H_{24}N_2O_2$ (needles, m. p. 204—205°), and with hydroxylamine hydrochloride to form 2 : 4 : 6-*triphenyl*-3-*methylpyridine*, $C_{24}H_{19}N$ (needles, m. p. 141—142°), this base yielding a *picrate* (yellow prisms, m. p. 190—191°) and a *hydrochloride* in colourless, hygroscopic needles.

Acetophenone and benzalpropiophenone in presence of sodium ethoxide react to form: (i) 2-phenyl-1 : 3-dimethyl-1 : 3-dibenzoylpropane, $C_{25}H_{24}O_2$ (six-sided crystals, m. p. 162—163°. *Trans.*, 1901, **79**, 936); (ii) a mixture of 2-phenyl-1 : 3-dibenzoylpropane, $C_{23}H_{20}O_2$ (Kostanecki and Rossbach, *Ber.*, 1896, **29**, 1492), and 2-phenyl-1-methyl-1 : 3-dibenzoylpropane, $C_{24}H_{22}O_2$ crystallising in prisms melting at 93—94°; (iii) 2-phenyl-1-methyl-1 : 3-dibenzoylpropane, $C_{24}H_{22}O_2$ (prisms, m. p. 103·5—104·5°); (iv) 2 : 4-diphenyl-1-methyl-1 : 3 : 5-tribenzoylpentane, $C_{39}H_{34}O_3$ (rhombic plates, m. p. 241—242°); (v) 2 : 4-diphenyl-1 : 3 : 5-tribenzoylpentane, $C_{38}H_{32}O_3$ (glistening prisms, m. p. 255—256°) (Kostanecki and Rossbach, *Ber.*, 1896, **29**, 1492); (vi) benzoic acid; (vii) a pink, viscid, acid liquid.

The two homologous 1 : 5-diketones indicated under (ii) could not be separated by solvents, but were identified by means of the corresponding dioximes and pyridines, namely: the dioxime, $C_{23}H_{22}N_2O_2$ (needles, m. p. 163—164°), and 2 : 4 : 6-triphenylpyridine, $C_{23}H_{17}N$ (needles, m. p. 137—138°: Wislicenus and Newman, *Annalen*, 1898, **302**, 236), corresponding to 2-phenyl-1 : 3-dibenzoylpropane, and the dioxime, $C_{24}H_{24}N_2O_2$ (needles, m. p. 204—205°) and 2 : 4 : 6-triphenyl-3-methylpyridine, $C_{24}H_{19}N$ (needles, m. p. 141—142°), corresponding to 2-phenyl-1-methyl-1 : 3-dibenzoylpropane.

In presence of an alcoholic solution of sodium hydroxide, acetophenone and benzalpropiophenone reacted to form: (i) 2-phenyl-1 : 3-dimethyl-1 : 3-dibenzoylpropane, $C_{25}H_{24}O_2$ (six-sided crystals, m. p. 162—163°); (ii) the mixture of homologous 1 : 5-diketones (prisms, m. p. 93—94°).

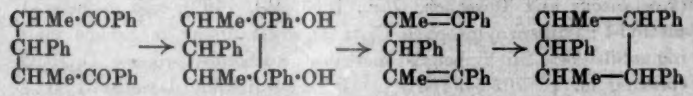
It is therefore evident that the reaction between acetophenone and benzalpropiophenone is not a condensation in the true sense of the word, and that the substances isolated are formed by the condensation

of the decomposition products of benzalpropiophenone (phenyl ethyl ketone and benzaldehyde) with benzalpropiophenone and acetophenone.

11. "A synthesis of 1 : 3 : 5-triphenyl-2 : 4-dimethyl*cyclo*pentane and of 1 : 3 : 5-triphenyl-2-methyl*cyclo*pentane." By R. D. Abell.

2-Phenyl-1 : 3-dimethyl-1 : 3-dibenzoylpropane, $C_{25}H_{24}O_2$ (*Trans.*, 1901, **79**, 936), when reduced by zinc dust and acetic acid, yielded the cyclic pinacone 1 : 3 : 5-triphenyl-2 : 4-dimethyl*cyclo*pentandiol, $C_{25}H_{26}O_2$ (prisms, m. p. 143—144°), and this on reduction with red phosphorus and hydriodic acid gave two isomeric 1 : 3 : 5-triphenyl-2 : 4-dimethyl*cyclo*pentanes, $C_{25}H_{28}$, the one crystallising in needles, m. p. 80—81°, the other being a yellow oil (b. p. 246—248°, 25 mm.).

When fused with oxalic acid, the pinacone loses two molecules of water (Fischer, *Ber.*, 1897, **30**, 559) to form the unsaturated hydrocarbon, 1 : 3 : 5-triphenyl-2 : 4-dimethyl*cyclo*pentadiene, $C_{25}H_{22}$ (needles, m. p. 127—128°), which, on reduction with red phosphorus and hydriodic acid, also gave both saturated hydrocarbons.

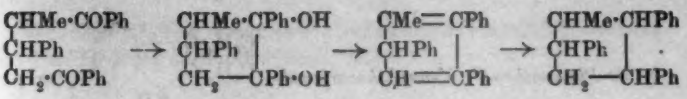


2-Phenyl-1-methyl-1 : 3-dibenzoylpropane, $C_{24}H_{22}O_2$, on reduction with zinc dust and acetic acid gave: (i) 1 : 3 : 5-triphenyl-2-methyl*cyclo*pentandiol, $C_{24}H_{24}O_2$; (ii) 1 : 3 : 5-triphenyl-2-methyl*cyclo*pentadiene, $C_{24}H_{20}$; the former is a brown oil crystallising with difficulty, the latter, which is probably due to the dehydration of the cyclic pinacone by acetic acid, forms yellow needles and melts at 162—163°.

The cyclic pinacone, $C_{24}H_{24}O_2$, obtained as an almost colourless oil by reducing the 1 : 5-diketone with sodium amalgam in moist ethereal solution, solidified in needles (m. p. 68—80°) when left in a vacuum over concentrated sulphuric acid, but could not be recrystallised from solvents as it always separated as an oil.

The cyclic pinacone, when fused with oxalic acid, gave the unsaturated hydrocarbon, 1 : 3 : 5-triphenyl-2-methyl*cyclo*pentadiene, $C_{24}H_{20}$ (yellow needles, m. p. 162—163°).

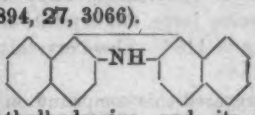
Both the pinacone and the unsaturated hydrocarbon gave two isomeric 1 : 3 : 5-triphenyl-2-methyl*cyclo*pentanes, $C_{24}H_{22}$, on reduction with red phosphorus and hydriodic acid, the one crystallising in needles (m. p. 121—122°), the other being a yellow oil (b. p. 260—262°, 28 mm.).

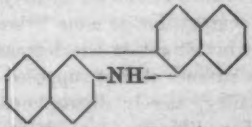


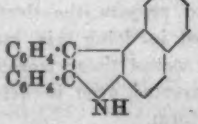
12. "**Formation of carbazoles by the interaction of phenols, in the orthoketonic form, with arylhydrazines.**" **By F. R. Japp and W. Maitland.**

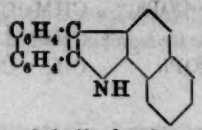
In a preliminary note (*Proc.*, 1901, **17**, 176) the authors showed that carbazoles could be obtained by heating certain phenols with arylhydrazines in presence of their hydrochlorides. They now find that the ease with which this reaction occurs is proportional to the readiness with which the phenol in question passes into the tautomeric orthoketonic form. Thus phenol itself does not yield any carbazole under the foregoing conditions; *α*-naphthol reacts, but with great difficulty, giving a very poor yield of the carbazole derivative; *β*-naphthol and 9-hydroxyphenanthrene react with relative ease. This is precisely the order of reactivity in the orthoketonic form, which Thiele's theory of double linkings would, in its application to benzene derivatives, predict for these phenols.

In addition to the carbazoles described in the preliminary note, the following have been prepared. The nomenclature adopted is that proposed by Graebe (*Ber.*, 1894, **27**, 3066).

s-1 : 2-*Dinaphthocarbazole*,  (m. p. 155°).—From *β*-naphthol, *β*-naphthylhydrazine and its hydrochloride; identical with "dinaphthyleneamine," which Walder (*Ber.*, 1882, **15**, 2173) obtained by heating *ββ*-dinaphthol with the double compound of zinc chloride and ammonia.

1 : 2 : 2′ : 1′-*Dinaphthocarbazole*,  (m. p. 231°).—From *β*-naphthol, *α*-naphthylhydrazine and its hydrochloride.

9 : 10-*Phenanthro*-1′ : 2′-*naphthocarbazole*,  (m. p. 220°).—From 9-hydroxyphenanthrene, *β*-naphthylhydrazine and its hydrochloride.

9 : 10-*Phenanthro*-2′ : 1′-*naphthocarbazole*,  (m. p. 225·5°).—From 9-hydroxyphenanthrene, α-naphthylhydrazine, and its hydrochloride.

In their first note on this subject (*loc. cit.*) the authors pointed out that 1 : 2-naphthocarbazole (phenyl-2-naphthylcarbazole), first prepared by Schöpff (*Ber.*, 1896, **29**, 269), melted at 134—135°, instead of, as stated by that investigator, at 120°. They had overlooked the fact that this correction had already been made by F. Ullmann (*Ber.*, 1898, **31**, 1697).

13. "Dimorphism of α-methylanhydracetonebenzil." By F. R. Japp and A. C. Michie.

α-Methylanhydracetonebenzil, $\begin{matrix}CPh=\!=CMe\\ |\\ CPh(OH)\cdot CH_2\end{matrix}\!>CO$, which is best obtained by the condensation of benzil with methyl ethyl ketone under the influence of a 0·5 per cent. solution of potassium hydroxide in absolute alcohol, was described by Japp and Meldrum (*Trans.*, 1901, **79**, 1029) as forming large, flat crystals of rhombic outline ("lozenge-shaped") melting at 118°. These crystals show oblique extinction in polarised light.

The authors prepared this compound on various occasions and were able to confirm the foregoing observations. About a year ago, however, although working under apparently the same conditions, they obtained a substance crystallising in octahedra which were isotropic in polarised light and melted at 133·5°. Analysis showed that this substance had the same composition as α-methylanhydracetonebenzil.

Further investigation has demonstrated that these two substances, which the authors at first supposed to be distinct chemical compounds, are, in reality, merely dimorphous forms of α-methylanhydracetonebenzil. The difficulty in proving this lay in the fact that, after the second form had once been obtained, it was apparently impossible again to prepare the first form. At last, however, the authors succeeded in doing this, but they were quite unable to obtain the result a second time; moreover, the substance was so unstable that it was converted, even in determining its melting point, into the less fusible form.

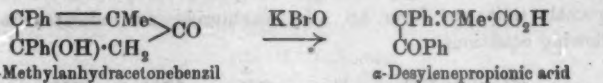
The authors wish to call attention to this dimorphism, as other investigators, who might happen to obtain the more stable form first,

would probably fail to recognise the substance as chemically identical with that formerly described (*Trans.*, *ibid.*).

14. "The oxidation products of the methyl homologues of anhydracetonebenzil." By F. R. Japp and A. C. Michie.

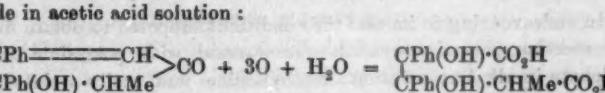
The various methyl homologues of anhydracetonebenzil were described by Japp and Meldrum (*Trans.*, 1901, 79, 1028, 1036, and 1037). The present authors have studied the oxidation of these substances, with the exception of $\alpha\beta\beta$-trimethylanhydracetonebenzil, which, owing to the difficulty of preparing it, was not included in the investigation.

Of the four methyl homologues examined, only α-methylanhydracetonebenzil is attacked by alkaline hypobromite:

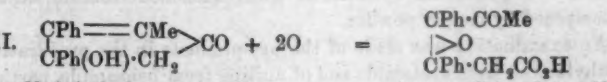


α-Methylanhydracetonebenzil (m. p. 118° and 133·5°). — α-Desyleneropionic acid (m. p. 174·5°).

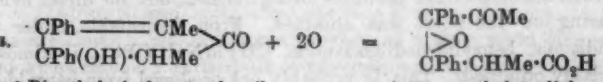
All four homologues are, however, readily oxidised by chromium trioxide in acetic acid solution:



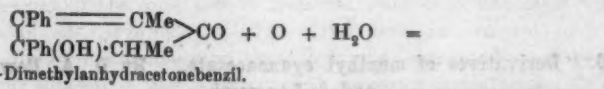
β-Methylanhydracetonebenzil (m. p. 180°). — α-Methyl-$\alpha'\beta$-diphenyl-$\alpha'\beta$-dihydroxyglutaric acid (m. p. 176°, with decomposition).



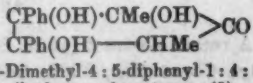
α-Methylanhydracetonebenzil (m. p. 118° and 133·5). — γ-Aceto-$\beta\gamma$-diphenyl-$\beta\gamma$-oxidobutyric acid (m. p. 131—132°).



$\alpha\beta$-Dimethylanhydracetonebenzil (m. p. 150°). — γ-Aceto-α-methyl-$\beta\gamma$-diphenyl-$\beta\gamma$-oxidobutyric acid (m. p. 164°, with decomposition).



$\alpha\beta$-Dimethylanhydracetonebenzil.



1 : 3-Dimethyl-4 : 5-diphenyl-1 : 4 : 5-trihydroxy*cyclo*pentanone-(2) (m. p. 89°).

IV. $\begin{matrix}CPh=\!=\!=CH\\ |\quad\quad\quad >CO\\ CPh(OH)\cdot CMe_2\end{matrix}$ + 3O = $\begin{matrix}CPh\cdot CO_2H\\ |\quad >O\\ CPh\cdot CMe_2\cdot CO_2H\end{matrix}$

ββ-Dimethylanhydracetonebenzil (m. p. 181°). aa-Dimethyl-a'β-diphenyl-a'β-oxidoglutaric acid (m. p. 171° and 184°).

The authors suggest the use of the prefix "oxido" to denote "bridge-oxygen" regarded as a bivalent substituent.

15. "Action of hypobromites on amides." By A. Lapworth and W. W. S. Nicholls.

The action of hypobromites on certain amides has been carefully studied with the idea that the change might depend on the formation, at an intermediate stage, of alkyl and cyanate ions, which would subsequently unite to form an alkyl carbimide, as indicated in the following equations:

$$CH_3\cdot CO\cdot NH_2 + Br_2 = \overset{+}{C}H_3 + \overset{-}{C}NO + 2HBr,$$

$$\overset{+}{C}H_3 + \overset{-}{C}NO = CH_3\cdot N{:}C{:}O.$$

In endeavouring to imitate the conditions supposed to obtain during the reaction, potassium cyanate was warmed with potassium methyl sulphate in alkaline solution; methylamine was easily isolated, but in comparatively small amount. It is well known that phenylcarbimide is formed when nascent phenyl groups (ions?) are produced in presence of potassium cyanate, as when benzenediazonium salts are decomposed by copper powder.

An examination was made of the bye-products in the preparation of methylamine from acetamide and of aniline from benzamide, particular attention being paid to the possibility of methyl alcohol and phenol or their decomposition products being formed, but no direct evidence bearing on the point was obtained. From benzamide, under these conditions, benzylidenedibenzamide, $CHPh(NHCOPh)_2$, is almost invariably obtained. This is probably not produced from benzaldehyde formed at an intermediate stage, as the aldehyde does not condense with benzamide under the experimental conditions.

16. "Derivatives of menthyl cyanoacetate." By D. A. Bowack and A. Lapworth.

A recent abstract (1903, 84, ii, 2) of a paper by Tschugaeff (*J. Russ. Phys. Chem. Soc.*, 1902, 34, 606—622) contains a reference to the optical rotation of menthyl cyanoacetate. As the authors have had

this compound and some of its derivatives under examination for several months, they wish to record certain of their observations.

Menthyl cyanoacetate, $CN\cdot CH_2\cdot CO_2\cdot C_{10}H_{19}$, prepared by heating the ethyl ester with menthol, crystallises in well-formed, flattened needles melting at 83—84°. In 2 per cent. solution in benzene, it had $[\alpha]_D^5 = -81{\cdot}12°$ (Tschugaeff gives $-80{\cdot}71°$) and no mutarotation could be detected. The *monobromo*-derivative, $CN\cdot CHBr\cdot CO_2\cdot C_{10}H_{19}$, crystallises in long needles and melts at 134—135°.

Menthyl p-*tolylazocyanoacetate*, $C_6H_4Me\cdot N_2\cdot CH(CN)\cdot CO_2\cdot C_{10}H_{19}$, crystallises in large, transparent, yellow plates melting at 93—95°; it has $[\alpha]_D = -53{\cdot}7°$ in benzene and does not exhibit mutarotation.

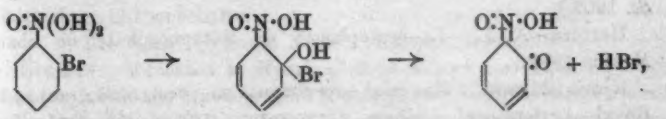
Menthyl p-*bromophenylazocyanoacetate*,

$$C_6H_4Br\cdot N_2\cdot CH(CN)\cdot CO_2\cdot C_{10}H_{19},$$

has been obtained in two forms, one crystallising in transparent plates melting at 97—98°, and the other in slender needles having a somewhat indefinite melting point.

17. "The influence of nitro-groups on the reactivity of halogen derivatives of benzene." By A. Lapworth.

Four years ago, the reactivity of the halogen atoms in the *ortho*- and *para*-halogenated nitrobenzenes was discussed on the assumption that an addition product, formed by adding the elements of water or another agent to the nitro-group, underwent change in the following way:



this reaction being impossible when the halogen is in the *meta*-position (Lapworth and Mills, *Proc.*, 1898, 14, 159).

This explanation, which was put forward at a time when the part played by quinonoid intermediate compounds in conditioning analogous changes was not generally recognised, is revived because other reactions of this type are now being explained on similar lines.

ADDITIONS TO THE LIBRARY.

I. Donations.

Dibdin, William Joseph. Public lighting by gas and electricity. pp. xx, 537, ill. London 1902. From the Author.

Lehfeldt, Robert A. A text-book of physics: with sections on the application of physics to physiology and medicine. pp. viii, 304, ill. London [1902]. From the Author.

Mayow, John. Untersuchungen über den Salpeter und den salpetrigen Luftgeist, das Brennen und das Athmen. Herausgegeben von F. G. Donnan. (*Being No.* 125 *of Ostwald's Klassiker.*)

From the Editor.

II. Pamphlets.

Ackroyd, William. On the circulation of salt and its bearing on geological problems, more particularly that of the geological age of the earth. (*From the Proc. Yorks. Geol. Poly. Soc.* 1902.)

Albo, Giacomo. Alcune considerazioni sul significato fisiologico degli alcaloidi vegetali. (*From the Nuovo giorn. bot. ital.* 1902.)

Bellati, M., and Finazzi, L. Sul calore che si produce bagnando le polveri. (*From the Atti. R. Inst. Veneto.* 1902.)

Harper, Henry Winston. A contribution to the chemistry of some of the asphalt rocks found in Texas. Austin, Texas, 1902.

Hebb, Thomas C. On a determination of the freezing-point depression constant for electrolytes. (*From the Trans. Nov. Scot. Inst. Sc.* 1902.)

Herrera, A. L. Le protoplasma de métaphosphate de chaux. Mexico 1902.

Kinch, Edward. Manurial experiments on permanent grass at the Royal Agricultural College, Cirencester. (*From the Agricultural Students' Gazette,* Dec. 1902.)

Storer, Francis Humphreys. Testing for mannose. (*From the Bulletin of the Bussey Institution* 1902.)

At the next ordinary meeting, on **Thursday**, February 5th, 1903, at **8** p.m., the following papers will be communicated:

"A new vapour-density apparatus." By J. S. Lumsden, D.Sc.

"A new principle for the construction of a pyrometer." By J. S. Lumsden, D.Sc.

CERTIFICATES OF CANDIDATES FOR ELECTION AT THE NEXT BALLOT.

N.B.—The names of those who sign from "General Knowledge" are printed in *italics*.

The following Candidates have been proposed for election. A ballot will be held on Wednesday, February 18th, 1903.

Alderton, Gilbert John,

"The Nest," Eglinton Road, Plumstead, London, S.E.

Student. Educated at King's College School and King's College, London. Obtained Mathematical Scholarship at King's College School, also Intermediate and Senior London County Council Scholarships. Honours Chemistry at Intermediate B.Sc. (Lond.). Daniell Scholarship for Chemical Research, King's College, London. Associate of Institute of Chemistry.

John M. Thomson.	D. Northall Laurie.
Herbert Jackson.	Fred. Carrodus.
Patrick H. Kirkaldy.	*W. D. Halliburton.*

Appleyard, George Henry,

151, Cleveland Street, Hull.

Analytical and Consulting Chemist. 3½ Years Student at the Yorkshire College, Leeds; 3½ years with Alfred H. Allen, Esq., West Riding of Yorkshire County Analyst, Sheffield. At present Analytical

and Consulting Chemist to the British Oil and Cake Mills, Ltd., Hull. Fellow of the Institute of Chemistry.

Alfred H. Allen.	Arthur Smithells.
G. E. Scott-Smith.	Herbert Ingle.
Julius B. Cohen.	*Wyndham R. Dunstan.*

Otto Hehner.

Atkinson, Edwin Bayles,

Scartho House, Gt. Grimsby.

Science Teacher. 1. Recognised by Board of Education as Teacher of Chemistry and Physics. 2. Late Demonstrator at Westminster School. 3. Undergraduate of London University. 4. Now Science Master at Gillingham (Dorset) Gram. School (Organised Science School).

Charles H. Bothamley.	*H. Brereton Baker.*
H. E. Hadley.	*Otto C. J. G. L. Overbeck.*
E. H. Winder.	*Willie Briggs.*

Alex. H. Bennett.

Bowen, William,

Clevedon, Woodend Road, Erdington.

Works Chemist. Have been Chemist at the Nickel Companies' Erdington Works the last four years; before then was a student at the Mason College for 4 sessions. I am an Associate of the Institute of Chemistry.

J. McCrae.	T. Slater Price.
Andrew Turnbull.	Percy F. Frankland.
C. F. Baker.	Cecil Leigh.

Bradbury, Samuel,

Thornham New Road, Castleton, Lancs.

Technical Chemist. Head Chemist for five years with Gartside et Cie., Malaunay, Seine Infre., France. Assistant to M. Horace Koechlin, Rouen (Founder of the *Revue Générale des Matières Colorantes*), to which journal contributed a "Note sur le danger du Chlorate et du Sulfocyanure" (June, 1897), also technical articles in the U.S. *Textile World* (August and September, 1897) and the Eng. *Textile Manufacturer* (September and October, 1897) on "The Printing of Metallic Powders on Calico." At present engaged on Research work under Prof. W. H. Perkin, jun., at Owens College.

H. B. Dixon.	Wm. A. Bone.
W. H. Perkin, jun.	D. L. Chapman.

J. Carter Bell.

Branch, George Thomas,

c/o Mr. G. Darroll, Harfield, Claremont, Cape Town, S. Africa.

Assayer and Chemist. Chemist and Druggist, Pharmaceutical Soc. of Great Britain. For 6 years Demonstrator in Practical Chemistry and Lecturer in Materia Medica and General Analytical work at Metropolitan College of Pharmacy, 160—162, Kennington Park Road, London. Joint Author on "Kino," published in *Chemist and Druggist*, Ap. 1898. Author of paper on "Rubber," published in *Pharmaceutical Journal*, and read before the Cape Pharmaceutical Society, Dec. 1900. Author of paper on "Ricinus species," 1902. Herbarium Medallist, Pharm. Soc. of G.B., 1892.

M. M. Pattison Muir.	W. Watson Will.
R. S. Morrell.	Peter MacEwan.
S. Ruhemann.	*Thos. Tyrer.*

Bywaters, Hubert William,

11, King Street, Regent Street, London, W.

Associate of the Royal College of Science, London [1900], Ph.D. (Würzburg), 1902. Engaged in Research in collaboration with Prof. Dr. W. Wislicenus (Tübingen Universität). Desirous of obtaining best current chemical literature and use of Reference Library.

M. O. Forster.	James C. Philip.
G. T. Morgan.	H. Burrows.

James D. Kettle.

Cadman, William Henry,

Lord Williams's Grammar School, Thame, Oxon.

Science Master. Candidate has passed the Final B.Sc. degree (Wales) examinations in Inorganic and Organic Chemistry after studying at the Univ. College of N. Wales, Bangor, under Prof. James J. Dobbie, M.A., D.Sc., F.C.S.

R. Hornby.	*W. A. Lethbridge.*
Alexander Lauder.	*W. T. B. Ridge.*
Percy Elford.	*James Robson.*

Castell-Evans, John,

141, Ferme Park Road, Crouch End, N.

Senior Demonstrator in the Chemical Department of the City and Guilds' Technical College, Finsbury. Studied under the late Sir Edward Frankland, afterwards acted as Demonstrator under him. Since 1880, have been in my present position, lecturing on Chemistry,

Metallurgy, &c. Author of "Experimental Chemistry," "Key and Companion to Experimental Chemistry," "Physico-chemical Tables," &c.

Raphael Meldola. Lewis Eynon.
F. Southerden. B. E. R. Newlands.
Arthur R. Ling.

Codling, Arthur John,

5, Tavistock Square, London, W.C.

Analytical Chemist. Assistant to Dr. Augustus Voelcker & Sons. Late Assistant to Francis Sutton, Esq., F.C.S., F.I.C., of Norwich.

J. Augustus Voelcker. Harry M. Frear.
E. W. Voelcker. Thos. Howard.
Francis Sutton.

Cousins, Francis George,

Stanley House, 56, Queen's Road, London, N.

Science Master. Educated at City of London School. Late Chemical Student at the City and Guilds Technical College, Finsbury, under Prof. R. Meldola, F.R.S. Science Master at the College, Beccles, Suffolk. Late Science Master, Andover Grammar School.

R. Meldola. W. A. Handcock.
F. Southerden. *R. C. T. Evans.*
J. B. Knight.

Coyle, Benjamin Claxton,

City Laboratory, 17, Castle Street, Dublin, and 65, Lansdowne Road, Dublin.

Chemical Analyst. Assistant to Sir Charles A. Cameron, C.B., M.D., F.R.C.S.I. I studied for 2½ years under Professor J. Emerson Reynolds, F.R.S., at the University of Dublin, both Inorganic and Organic Chemistry. I have been assistant to Sir Charles A. Cameron, C.B., M.D., &c., Public Analyst, for nearly twelve years, both in the Laboratory and at his Lectures at the Royal College of Surgeons.

Julius Ostersetzer. J. Emerson Reynolds.
E. S. Cameron. Ch. R. C. Tichborne.
Emil A. Werner. *W. E. Adeney.*

Desch, Cecil Henry,

Instow, Mount Pleasant Road, South Tottenham, London, N.

Assistant to Prof. A. K. Huntington, Metallurgical Laboratory, King's College, W.C. Studied 1889—1892 at Technical College,

Finsbury. From 1892—1900, Chemist to Messrs. F. Kendall and Son, Stratford-on-Avon. Passed Institute of Chemistry examination in 1895, and London B.Sc., with 1st Class Honours in Chemistry, same year. Worked 1900—1902 at Würzburg University under Prof. Hantzsch, and obtained degree of Ph.D. summa cum laude. Obtained London D.Sc., 1902. Papers, Meldola and Desch, "Naphthalene Derivs.," Trans., 1892, 765; Hantzsch and Desch, "Organische Ferriverbindungen," *Lieb. Ann.*, 323, 1.

A. K. Huntington. R. Meldola.
William Ramsay. Morris W. Travers.
R. C. T. Evans.

Elford, Archibald Sefton,
9, Keble Road, Oxford.

Obtained Honours in Natural Science (Chemistry) at Oxford in the Final Examination. Has since studied food and drug analysis.

H. Macan. John Watts.
V. H. Veley. J. E. Marsh.
W. W. Fisher. P. Elford.

Farmer, Robert Crosbie,
154, Eglinton Road, Woolwich.

Chemical Assistant in Research Dept. of Royal Arsenal, Woolwich. M.Sc. (Victoria), Ph.D. (Würzburg). Contributions to chemical science as follows: "Die Constitution der sogen. Oxyazokörper," *Ber.*, 32, 3081; "α-Oximidoketone und Chinonoxime als Pseudosäuren," *Ber.*, 32, 3101; "Hydrolyse von Natriumphenolaten," see *Ber.*, 32, 3080 (the above were done in collaboration with Prof. Hantzsch); "Liquid Nitrogen Peroxide as a Solvent," Trans., 79, 1356 (with Prof. Frankland); "A new method for the determination of hydrolytic dissociation," Trans., 79, 863. For some time I was a demonstrator at Birmingham University.

Percy F. Frankland. Thomas H. Pope.
T. Slater Price. Adrian J. Brown.
Alex. McKenzie. O. Silberrad.

Hindmarsh, Leonard King,
354, Lordship Lane, S.E.

B.A. Balliol College, Oxford 2nd class Natural Science, 1900. Chemistry Master, Alleyn's School, Dulwich.

H. Brereton Baker. Allen F. Walden.
D. H. Nagel. *N. V. Sidgwick.*
Harold Hartley. *R. T. Lattey.*

Howorth, Franklin Wise,

Rose Bank, Elmdale Road, Palmer's Green, N.

Technical Chemist. Associate of the Chartered Institute of Patent Agents. Twelve years with Robt. Rumney, Manufg. Chemist, Ardwick, Manchester. Part of time superintended various manufactures, including Acetate of Iron, Nitrates of Iron and Copper, Acetic Acid, Wood Spirit, Verdigris, Chromium Acetate, Manganese Sulphate, Nitric Acid, Cylinder Hydrochloric Acid, Stannate of Soda, and Tin Salts generally. Glauber's Salts, Caustic Potash, and soluble Alkaline Silicates. Nearly two years Chemist to the late J. H. Parkinson, Compressed Gas Engineer, Stratford, Lancashire. There I conducted experiments in oxygen manufacture. Now and for past seven years advising Chemist to Mr. W. Lloyd Wise, C.P.A. Hold 1st class certificates Owens College (Evening), 1st, 2nd, and 3rd years' lecture course, and 2nd year's laboratory course.

Otto Hehner. B. E. R. Newlands.
C. C. Hutchinson. F. Napier Sutton.
Oscar Guttmann. *Watson Smith.*

Thomas Tyrer.

Huyin, Moung Tha, B.A., (Cal.), M.R.A.S.,

"Burma," 18, Mercers Road, London, N.

Student member, Lincoln's Inn. Passed in Chemistry, Calcutta, B.A., Examination, 1898.

Thomas Wardle. Edward W. Lewis.
Gerald T. Moody. R. Steele.
William A. Davis. *J. Carter Bell.*

Harold Hartley.

Kemp-Welch, Maurice,

Parkstone, Weybridge, Surrey.

Graduate of Cambridge University. Natural Science Tripos, Part I (2nd). Late Hon. Exhibitioner King's College, Cambridge.

W. J. Sell. Charles T. Heycock.
H. O. Jones. Jas. Kewley.

Thos. R. Duggan.

Lees, Frederic Herbert,

256, Park Road, Crouch End, London, N.

Research Chemist in the Wellcome Chemical Research Laboratories. Studied Chemistry at the Owens College, Manchester, where I

subsequently, and for two years, held the post of Private Assistant to Prof. W. H. Perkin. Have contributed several papers to the Society's Transactions.

H. B. Dixon. Wm. A. Bone.
W. H. Perkin, jun. G. H. Bailey.
F. B. Power.

Leigh, Arthur Graham,

Chorcliff House, Chorley, Lancs.

Rivers Inspector. Served for six years and over as assistant inspector to the Ribble Joint Committee. During that time he underwent a chemical training in the Committee's Laboratory at Preston, and has had experience in the analysis of water, sewage, trades waste, &c., and has assisted in the various chemical investigations published from that laboratory.

Wm. Naylor. Jno. T. Brierley.
Wm. Jas. Orsman. *Arthur Smithells.*
Julius B. Cohen.

Lewis, Harry Percy,

Hematite House, Swansea Hematite Iron and Steel Works, Landore, R.S.O., South Wales.

Head Chemist and Assistant Works Manager. During the years 1889 and 1890, I successfully passed the following South Kensington examinations. Honours Practical Inorganic Chemistry, Advanced Theoretical Inorganic Chemistry, the elementary Stages of Practical and Theoretical Organic Chemistry and Machine Drawing. I have also had the management of the Laboratory and other departments at the above Works for the last 14 years.

Frank B. Last. Thomas Sandford.
Rhys P. Charles. Herbert Eccles.
Charles Crocker.

Mander, Percy George,

Spon House, Spon End, Coventry.

Science Master, Grammar School, Ashby-de-la-Zouche. B.Sc., Lond. First Class Chem. Hon. Royal Coll. Sci., Lond. First Class, third year chem. R.C.S., Lond., one year; Mason Univ. Coll., Birmingham, three years.

Percy F. Frankland. M. O. Forster.
William A. Tilden. G. T. Morgan.
James C. Philip.

O'Brien, Frederick,

15, Lilymead Avenue, Knowle, Bristol.

Analytical Chemist. 1896—1899, Studied Chemistry at University College, Liverpool. Took degree of B.Sc. Honours in Chemistry, Victoria University, 1899. Proceeded to M.Sc. Degree in 1902. For about 18 months in Laboratory of Public Analyst for the City of Liverpool and County of Lancaster. From Jan., 1901, to present time, Chemist to the Western Tanning Co., Bedminster, Bristol.

J. Campbell Brown. Charles A. Kohn.
W. Collingwood Williams. Ernest Bowman Ludlam.
Sydney Young.

Samuel, Thomas,

School of Science and Art, Liscard, Cheshire.

Organising Secretary to the Technical Instruction Committee of the Wallasey Urban District Council. Teacher of Chemistry in Public Secondary Schools and, since July, 1897, Director of all Science and Technical Classes in the Wallasey District (population 55,000), B.A., Inter. B.Sc. (London).

J. Parry Laws. R. Henry Jones.
Charles J. Mansford. *F. H. Tate.*
Edward Davies.

Scholefield, Alfred Henry,

4, Hartley Terrace, Wolverhampton.

Schoolmaster. Science Master, Wolverhampton Grammar School. B.A., B.Sc., London University.

J. H. Hichens. Frank Brownsword.
J. T. Dunn. Wm. Whitehouse.
W. H. C. Jemmett. A. E. Dunstan.

Sibley, Samuel Edward,

3, Rutland Road, Ilford.

Technical Chemist. Have occupied position as deputy manager, Messrs. A. Boake, Roberts & Co., Manufacturing Chemists, Stratford, and as head assistant in their laby. under W. B. Giles, F.I.C.

R. Meldola. T. FitzGibbon.
F. Southerden. *E. Haynes Jeffers.*
Geo. Patterson.

Steven, Alec Bowring,

Ness House, Surbiton, Surrey.

Assistant Lecturer on Dyeing at the Yorkshire College, Leeds. B.Sc., London. Six years at University College. Joint author with Mr. A. G. Perkin of "Purpurogallin. I.," in *Journal*, 1903.

A. G. Perkin. H. M. Dawson.
William Ramsay. Morris W. Travers.
A. G. Green.

Thomson, George Malcolm,

Newington, Dunedin, N.Z.

Science Teacher. Have been teaching Chemistry in the Otago High Schools for over twenty years. Examiner in the University, &c.

John R. Don. O. Gore Adams.
Thomas H. Easterfield. A. Liversidge.
B. C. Aston. *J. S. Maclaurin.*

Tilburn, Charles,

31, Hardy Street, South Yarra, Melbourne, Victoria.

Assistant Lecturer in Chemistry, Geology, and Mineralogy, School of Mines, Stawell, Victoria. Passed Victorian Departmental Examinations in Metallurgy and Chemistry courses; lately Assistant Demonstrator in Chemistry, Working Men's College, Melbourne; Lecturer, Chemistry, &c., School of Mines, Stawell.

D. Avery. Orme Masson.
A. W. Craig. *Fred. W. Steel.*
Henry C. Jenkins.

Tolson, Stanley,

14, Furnivall Road, Balby, Doncaster.

Analytical Chemist. Assistant to the Great Northern Railway Co.'s Analyst. Two years student at the Yorkshire College, Leeds (Organic and Inorganic Chemistry, Physics and Dyeing). One year with Messrs. Read, Holliday & Sons, Ltd., Huddersfield, as Chemist (Chemical and Aniline Dye Manufacturers). One year in the Chemical Institute of Herr Gehr. Prof. Dr. Emil Fischer (Berlin University). Joint author with Dr. Otto Diels, "Ueber die Nitrirung des 2-Aminofluorens," published in the *Berichte*, August, 1902. Completed nine months with G.N.R. Analyst, and still there doing general chemical analysis.

Arthur Smithells. Emil Fischer.
Julius B. Cohen. Walter Leach.
John K. S. Dixon.

Toyne, Francis Digby,

Santubong, Saräwak.

Chemist, c/o Messrs. Saräwak Cutch Co. Ltd., Santubong, Saräwak. Training acquired at the Yorkshire College, Leeds, in the Dyeing and Chemistry Departments; also in Germany at Messrs. Bayer's of Elberfeld. Associate of the Society of Dyers and Colourists. Honours in City and Guilds Examination in Dyeing and for 2 years in charge of the Laboratory, Saräwak Cutch Company, Ltd., &c.

Henry R. Procter. Arthur Smithells.
Andrew Turnbull. E. J. Wilkinson.
S. Arch. Vasey.

Turner, Duncan,

Elmbank, Broomhouse, By Glasgow.

Assistant Lecturer on Chemistry and Metallurgy. Received training under Prof. Watson, Anderson's College, Glasgow. For three years Assistant in the Chemical and Metallurgical Laboratory of Coatbridge Technical School and Mining College.

James McCutcheon. R. R. Tatlock.
Andrew Turnbull. H. Procter Smith.
Geo. Ritchie.

Wadmore, John Mello, B.A. (Oxon.),

"Meriden," Exmouth, S. Devon.

Science Master, Aldenham School, Nr. Elstree, Herts. Late Scholar Trin. Coll., Oxon. First Class Honours Final Honours School, Natural Science, Oxford. Joint Author "The Constitution of Hydrocyanic, Cyanic, and Cyanuric Acids," *Journal Chem. Soc.*, March, 1902. "Nitrogen Chlorides and Bromides derived from *o*-Substituted Anilides," *Journal*, July 1902. "The Cloëz Reaction," *Proceedings*, March 1902.

F. D. Chattaway. D. H. Nagel.
K. J. P. Orton. R. T. Lattey.
W. H. Hurtley. Allan F. Walden.

Walsh, Thomas Crosbie,

"Sunnyside," Muswell Avenue, Muswell Hill, N.

Chemist. Certificated Student in Chemistry, City and Guilds Technical College, Finsbury (Professor R. Meldola, F.R.S.). Late Chemist to Dental Manufacturing Company, Lexington Street, W. Chemist to Borax Consolidated, Ltd., Antofagasta, Chile, S. America.

R. Meldola. F. Southerden.
W. A. Handcock. J. V. Eyre.
W. H. Barlow.

Williams, David John,

1, St. Agnes Place, Kennington Park, London, S.E.

Lecturer, Demonstrator in Chemistry and Histology at the Metropolitan College Pharmacy. Sessional Silver Medallist at the Metropolitan College Pharmacy. Major Qualification, Pharmaceutical Society. Advanced Certificates Mathematics, Chemistry (Inorganic), and Mechanics.

W. Watson Will.	F. B. Power.
Thos. Tyrer.	*Peter MacEwan.*
Edward Divers.	*W. L. Howie.*

Wilmore, Albert,

158, Skipton Road, Colne.

Principal, Municipal Technical School, Colne. Twelve years a Teacher of Chemistry, Inorganic and Organic. For three years Chemist to large Tanning, Fellmongering, Degreasing, and Leather Dyeing Works of Messrs. W. and J. Sagar, Colne, Lancs., and Hackbridge, London. Contributed several Chemical Processes to the industry, which are now working successfully. At present Consulting Chemist to same firm, and to other firms in district (as occasional chemist).

William A. Tilden.	James C. Philip.
W. Palmer Wynne.	W. B. Hards.
Chapman Jones.	*Henry R. Procter.*

Yeomans, William Wade,

Middlewich, Cheshire.

Research Chemist and Analyst. Works Chemist. Was engaged as apprentice in the Works of Messrs. Murgatroyd and Co., Middlewich; then two Sessions in the Chemical Department, Technical School; afterwards 5½ years with Messrs. Levinstein and Co., Blackley.

James Grant.	F. S. Sinnatt.
Herbert N. Morris.	L. G. Radcliffe.
Jul. Hübner.	

Young, Andrew,

1, Avenue Terrace, Cape Town.

Professor of Geology and Mineralogy in South African College, Cape Town. M.A. and B.Sc., Edin. University. Formerly Demonstrator in Chemical Department, Heriot Watt College, Edinburgh. Now Professor of Geology and Mineralogy in South African College.

Alex. Crum Brown.	Hugh Marshall.
J. Gibson.	D. Brown.
Leonard Dobbin.	John S. Ford.

The following were authorised by the Council under Bye-law I. (3):

Bhaduri, K.,

Canning College, Lucknow.

M.A. in Chemistry. 1st in First Division and Gold Medallist, 1889, Calcutta University. Worked as Personal Assistant to Professor Pedlar, F.R.S., Presidency College, Calcutta, in carrying out some of his researches. Some time Professor of Applied Chemistry, Technical Institute, Baroda. Late Professor of Physics and Chemistry, Bishop's College, Calcutta. Professor of Chemistry, Canning College. Now making researches on some raw products of India.

A. Sanyal. *Alex. Pedler.*
E. G. Hill. *Arthur Richardson.*

Prichard, George Montague,

Ramtek, Nagpur, C.P., India.

Analyst to Central Provinces of India Prospecting Sete. Three years' service with Edwd. Riley, F.I.C., F.C.S. Obtained every Chemistry Prize at Felsted School for which I was entitled to enter, under A. E. Munby, F.C.S. Obtained highest marks in the School in Oxford Junior Local in Chemistry at 13 years of age. Two years service as Chemist to 14 Manganese Properties in India.

Edwd. Riley. Alan E. Munby.

RICHARD CLAY AND SONS, LIMITED, LONDON AND BUNGAY.

Issued 11/2/03

PROCEEDINGS

OF THE

CHEMICAL SOCIETY.

Vol. 19. No. 260.

Thursday, February 5th, 1903. Dr. E. DIVERS, F.R.S., Vice-President, in the Chair.

Mr. W. Carter White was formally admitted a Fellow of the Society.

Certificates were read for the first time in favour of Messrs.:

Arthur William Eastwood, B.A., Newton College, S. Devon.
John Percy Edgerton, 39, White Hart Lane, Barnes, S.W.
George Howsam, School of Science, Peterborough.
Alfred Owen Jones, 18, Queen's Gardens, Tetherdown, Muswell Hill.
James Stewart Kerr, The Grove, Ladywood Road, Birmingham.
George Siddle, Middleton-One-Row, R.S.O.
William Francis John Wood, B.Sc., Doncaster Road, Barnsley.
Edward Chancey Worden, Millburn, New Jersey, U.S.A.

Of the following papers, those marked * were read:

*18. "The solubilities and transition points of lithium nitrate and its hydrates." By F. G. Donnan and B. C. Burt.

Lithium nitrate was found to yield two hydrates, $LiNO_3,3H_2O$ and $LiNO_3,\frac{1}{2}H_2O$. Of these, the former has been obtained previously by

Dott, who showed it to be the trihydrate and not $LiNO_3,2\frac{1}{2}H_2O$ as stated by Kremers and by Troost. Determinations of the solubility of these hydrates and also of the anhydrous salt were carried out, and in this way the various quadruple points of the system located, the position of these points being also confirmed by thermometric and dilatometric measurements. The trihydrate is of special interest as it possesses a stable melting point. The equilibrium curve in the neighbourhood of this point was fully investigated.

The following is a list of the melting points and quadruple points of the system:

Cryohydrate point of $LiNO_3,3H_2O$, $-17{\cdot}8°$.

Melting point of $LiNO_3,3H_2O$, $29{\cdot}88°$.

Transition point, trihydrate + semihydrate $\rightleftharpoons$ saturated solution, $29{\cdot}6°$.

Transition point, semihydrate $\rightleftharpoons$ anhydrous salt + saturated solution, $61{\cdot}1°$.

*19. "The synthesis of *aa*-diglutaric acid." By O. Silberrad and T. H. Easterfield.

The action of iodine on the sodium derivative of ethyl *a* carboxyglutarate does not lead to the formation of the hexa-ethyl ester, $CO_2Et{\cdot}CH_2{\cdot}CH_2{\cdot}C(CO_2Et)_2{\cdot}C(CO_2Et)_2{\cdot}CH_2{\cdot}CH_2{\cdot}CO_2Et$, from which *aa*-diglutaric acid could be obtained by successive hydrolysis and loss of carbon dioxide, but gives rise to the hitherto unknown *ethyl a-iodo-a-carboxyglutarate* (*ethyl a-iodobutane-aaγ-tricarboxylate*), the reaction taking place in accordance with the following equation:

$$CO_2Et{\cdot}CH_2{\cdot}CH_2{\cdot}CNa(CO_2Et)_2 + I_2 = CO_2Et{\cdot}CH_2{\cdot}CH_2{\cdot}CI(CO_2Et)_2 + NaI.$$

Bromine behaves similarly, yielding *ethyl a-bromo-a-carboxyglutarate* (*ethyl a-bromobutane-aaγ-tricarboxylate*) (sp. gr. 1·325 at 15°/4°).

Again, on heating the sodium derivative with these halogenated esters, no condensation occurred, but instead a mixture of alkyl carboxyglutarate and a new ethyl carboxyglutaconate (b. p. 173—176° under 15 mm. pressure) was produced, the latter differing from its isomeride (ethyl *iso*aconitate) in that it does not contain a mobile hydrogen atom and can therefore neither assume the enolic form nor yield a sodium derivative.

As the preceding method failed to give rise to the desired ester, its synthesis was next tried by one of the authors (O. S.) in the manner represented by the following equation:

$$\begin{matrix} CO_2Et\cdot CH_2\cdot CH_2I \\ CO_2Et\cdot CH_2\cdot CH_2I \end{matrix} + \begin{matrix} NaC(CO_2Et)_2 \\ NaC(CO_2Et)_2 \end{matrix} = 2NaI + \begin{matrix} CO_2Et\cdot C_2H_4\cdot C(CO_2Et)_2 \\ CO_2Et\cdot C_2H_4\cdot C(CO_2Et)_2. \end{matrix}$$

This process proved successful and yielded ethyl $\alpha\alpha$-di-α-carboxyglutarate (isolated as $\alpha\alpha$-diglutaric acid) together with ethyl $\Delta^{\alpha\beta}$-α-dihydromuconate (?), ethyl butane-$\alpha\gamma\gamma\delta\delta$-pentacarboxylate (b. p. 215—218° under 17 mm. pressure), which, on saponification, yielded butane-$\alpha\gamma\delta$-tricarboxylic acid (m. p. 122°), and ethyl ethylenetetracarboxylate.

A fractionator was described for distilling under greatly diminished pressure; this apparatus was designed in order to overcome the difficulty due to the variation of pressure caused by throttling, which is experienced under these conditions when the ordinary columns are employed.

***20. "Distillation of chlorine water." By A. Richardson.**

Pickering (*Trans.*, 1870, **37**, 139) has shown that, when aqueous solutions of chlorine are heated in an open vessel, a residue containing hydrochloric acid remains behind after all the active chlorine has been expelled, and the present work was undertaken in order to find out whether the escaping chlorine was present wholly in a free state or mixed with one of its oxy-acids.

When chlorine water was heated in a retort, the distillate, which was obtained below 100°, contained free chlorine, the gas being readily displaced by a current of air; the solution in the retort, however, still contained active chlorine, for it liberated iodine from potassium iodide, bleached indigo solution immediately, and gave, on shaking with mercury, a brownish-yellow deposit resembling that obtained with hypochlorous acid. This result proved to be independent of the action of light, and was not influenced by further purification of the chlorine.

Quantitative estimations of the chlorine in the aspirated distillate gave, for the active chlorine estimated iodometrically, values double those obtained for the total chlorine found with silver nitrate after treatment with sulphur dioxide. These results show that the active chlorine is present as hypochlorous acid.

Distillation of chlorine water in a current of chlorine gas showed that the hydrochloric acid formed in the residual solution was equivalent to the hypochlorous acid found in the distillate, indicating that a portion of the chlorine reacts with the water according to the equation $Cl_2 + H_2O = HCl + HClO$.

Again, when aliquot parts of the distillate and residue obtained on distilling chlorine water were mixed, a solution having all the properties of the original chlorine water was reproduced. It would appear,

therefore, that hydrochloric and hypochlorous acids are separated during distillation as the products of the partial change of chlorine water.

When chlorine water was heated in a flask provided with a reflux condenser, so that the distillate returned to the original solution, the ratio of active to total chlorine found was that required for a solution of free chlorine, showing that the solution is stable when the separation of the two acids is prevented.

A further study of the change showed that the amount of hypochlorous acid passing over decreased with the increase in strength of the hydrochloric acid formed in the solution. With very dilute solutions of chlorine water, the whole of the free halogen employed entered into reaction with the solvent, the oxy-acid only having been found in the distillate.

Finally, distillation of very dilute chlorine water in a vacuum at the ordinary temperature gave a distillate containing the oxy-acid, showing that the reaction occurs at the ordinary temperature as well as at the boiling point.

21. "A new vapour density apparatus." By John S. Lumsden.

This apparatus is based on the principle that the molecular weights of all substances in the state of gas, when occupying the same volume and at the same temperature, exert the same pressure. The pressure produced at a given temperature by the molecular weight in milligrams is either found experimentally by vaporising a substance of known molecular weight or calculated from the dimensions of the apparatus; then, from the pressure produced by vaporising a weighed quantity of the substance the molecular weight of which is required, the weight in milligrams which would produce the milligram molecular pressure is found. This is taken as the molecular weight.

No barometric reading is necessary, and when the constant of the apparatus has been found and the substance weighed, the experiment is completed in two minutes, and the calculation of the result may be made in another two minutes.

By slightly modifying the arrangement of the apparatus, the substance may be vaporised under diminished pressure or in an inert gas, and the experiment may be performed at any temperature. The instrument, which is quite as accurate as the Victor Meyer apparatus, is, owing to its simplicity, well adapted for general laboratory work.

22. "A new form of pyrometer." By John S. Lumsden.

A constant volume instrument was described in which a weighed quantity of a substance is vaporised and the pressure measured by a mercury gauge.

The pressures produced by equal weights of substance are proportional to the absolute temperatures; therefore, if at two temperatures the pressures produced by equal weights are measured and one temperature is known, the other can be calculated.

The instrument may be made of glass, porcelain or metal, and high temperatures may be measured within a few degrees.

23. "Tertiary butylphenol." By E. W. Lewis.

The author draws attention to the non-formation of phenyl-*ter.*-butyl ether on digesting phenol in alcoholic solution with *ter.*-butyl-chloride and excess of alkali, and to the production in these circumstances of the isomeric *ter.*-butylphenol. Other instances of the difficulty attending the preparation of phenol ethers containing a tertiary radicle in place of the hydrogen of the phenolic hydroxyl group are cited in the paper.

ADDITIONS TO THE LIBRARY.

I. Donations.

Danger, Ferdinand Philippe. The art of glass-blowing, or plain instructions for making the chemical and philosophical instruments which are formed of glass. ill. London 1831.

Baumé, Antoine. Mémoire sur la meilleure manière de construire les alambics et fourneaux propres à la distillation des vins pour en tirer les eaux-de-vie. ill. Paris 1778.

Klaproth, Martin Henry. Analytical essays towards promoting the chemical knowledge of mineral substances. Translated from the German. London 1801.

Rideal, Samuel. Glue and glue testing. London 1900.

From the Author.

Bigelow, W. D. Foods and food control. Parts I—V. (*being* U.S. Dept. of Agriculture, Bureau of Chemistry, Bulletin No. 69.), Washington 1902.

II. By Purchase.

Boyle, Robert. De ipsa natura, sive libera in receptam naturæ notionem disquisitio ad amicum. London 1687.

Rây, Praphulla Chandra. A history of Hindu chemistry from the earliest times to the middle of the sixteenth century A.D. with Sanskrit texts, variants, translation, and illustrations. Vol. I. London 1902.

Lévy, Lucien. Les mouts et les vins en distillerie. Paris 1903.

Whetham, William Cecil Dampier. A treatise on the theory of solution, including the phenomena of electrolysis. Cambridge 1902.

ANNIVERSARY DINNER.

It has been decided by the Council to arrange for a Dinner of the Fellows of the Society and their friends on **Wednesday, March 25th, 1903**, this being the day fixed for the Annual General Meeting. Further particulars will be announced shortly.

At the next meeting, on **Wednesday, February 18th, at 5.30 p.m.**, there will be a ballot for the election of Fellows, and the following papers will be communicated:

"The molecular rearrangement of *N*-substituted imino-ethers." By G. D. Lander.

"The nature and probable mechanism of metal replacement in tautomeric compounds." By G. D. Lander.

"The chlorine derivatives of pyridine. Part VIII. The interaction of 2:3:4:5-tetrachloropyridine with ethyl sodiomalonate." By W. J. Sell and F. W. Dootson.

"The biological method for resolving inactive acids into their optically active components." By A. McKenzie and A. Harden.

RICHARD CLAY AND SONS, LIMITED, LONDON AND BUNGAY.

Issued 28/2/03

PROCEEDINGS

OF THE

CHEMICAL SOCIETY.

Vol. 19. No. 261.

Wednesday, February 18th, 1903. Professor J. Emerson Reynolds, Sc.D., F.R.S., President, in the Chair.

Mr. J. P. Millington was formally admitted a Fellow of the Society.

Certificates were read for the first time in favour of Messrs.

Robert Gordon Bibby, New College, Oxford.
Thomas Divine, M.B., C.M., 11, Spencer Place, Leeds.
Archibald Louis Robinson, B.A., 40, Trinity College, Dublin.
Montague White Stevens, 2, Richmond Place, London, S.W.

It was announced that the following changes in the Officers and Council were proposed by the Council:

As President: Prof. Tilden, F.R.S., *vice* Prof. J. Emerson Reynolds, F.R.S.

As Treasurer: Dr. Horace T. Brown, F.R.S., *vice* Prof. Tilden, F.R.S.

As Secretary: Prof. Wynne, F.R.S., *vice* Prof. Dunstan F.R.S.

As Vice-Presidents: Prof. Dunstan, F.R.S., and Mr. David Howard, *vice* Prof. Divers, F.R.S., and Dr. Stevenson.

As Ordinary Members of Council: Dr. J. T. Hewitt, Dr. C. A. Kohn, Dr. E. J. Mills, F.R.S., and Dr. S. Ruhemann, *vice* Mr. H. B. Baker, F.R.S., Dr. Chattaway, Prof. Clowes, and Dr. Lewkowitsch.

Dr. Hewitt, Dr. Thorne, and Dr. Orton were appointed to audit the Society's accounts.

INTERNATIONAL CONGRESS OF APPLIED CHEMISTRY.

By direction of the Council, the following letter was read announcing the formation of a Joint Organising Committee in this country in connection with the International Congress of Applied Chemistry which is to be held in Berlin next June.

SOCIETY OF CHEMICAL INDUSTRY,
PALACE CHAMBERS,
9, BRIDGE ST., WESTMINSTER, LONDON, S.W.

February 10th, 1903.

"*International Congress of Applied Chemistry, Berlin.*"

DEAR SIR,

I am directed to inform you that at the conference held at this office on the 6th inst. and referred to in my letter of the 26th ult., the following resolutions were passed:

1. That the delegates appointed by the Royal Society, Chemical Society, and Society of Chemical Industry, to represent these Societies at the International Congress of Applied Chemistry to be held in Berlin in June next, agree to form the joint Organising Committee contemplated in the letter of May 30th last from the President of the Organising Committee at Berlin.

2. That the Organising Committee so formed invites the co-operation of the other Learned and Industrial Societies in Great Britain, whose members are interested in Applied Chemistry.

3. That the President of the Society of Chemical Industry be requested to act as Chairman of this Organising Committee.

4. That Mr. C. G. Cresswell be requested to act as Secretary *pro tem.*

5. That a copy of these resolutions be communicated to Dr. Otto Witt, President of the Congress.

I remain,
Your obedient servant,
(signed) CHAS. G. CRESSWELL.

The Secretary,
Chemical Society.

The following delegates have been appointed by the Council to represent the Chemical Society at the Congress, Prof. Tilden, Prof. Dunstan, Prof. W. H. Perkin, jun., and Dr. A. Scott.

Fellows of the Society who propose to attend the Congress next June are requested to send their names to the Secretaries so that they may be communicated to the Organising Committee in Berlin.

A ballot for the election of Fellows was held and the following were subsequently declared duly elected:

Gilbert John Alderton.
George Henry Appleyard.
Edwin Bayles Atkinson.
K. Bhaduri, M.A.
William Bowen.
Samuel Bradbury.
George Thomas Branch.
Hubert William Bywaters, Ph.D.
William Henry Cadman.
John Castell-Evans.
Arthur John Codling.
Francis George Cousins.
Benjamin Claxton Coyle.
Cecil Henry Desch, Ph.D., D.Sc.
Archibald Sefton Elford, B.A.
Robert Crosbie Farmer, M.Sc., Ph.D.
Leonard King Hindmarsh, B.A.
Franklin Wise Howorth.
Moung Tha Huyin, B.A.
Maurice Kemp-Welch, B.A.
Frederic Herbert Lees.
Arthur Graham Leigh.
Harry Percy Lewis.
Percy George Mander, B.Sc.
Frederick O'Brien, M.Sc.
George Montague Prichard.
Thomas Samuel, B.A.
Alfred H. Scholefield, B.A., B.Sc.
Samuel Edward Sibley.
Alec Bowring Steven, B.Sc.
George Malcolm Thomson.
Charles Tilburn.
Stanley Tolson.
Francis Digby Toyne.
Duncan Turner.
John Mello Wadmore, B.A.
Thomas Crosbie Walsh.
David John Williams.
Albert Wilmore.
William Wade Yeomans.
Andrew Young, M.A., B.Sc.

Of the following papers, those marked * were read:

*24. "The molecular rearrangement of *N*-substituted imino-ethers." By G. D. Lander.

The rearrangement of the atomic grouping ·C(OR):N· into ·CO·NR· may be effected catalytically (Knorr and Wheeler) or by heating (Wislicenus), and both kinds of isomerisation have been studied with some of the recently prepared *N*-substituted imino-ethers.

Alkyl iodides prove more useful in the catalytic rearrangement than bromides or chlorides, and the isomerisation by means of iodides has been examined with the following imino-ethers: *N*-phenylacetimino-methyl and -ethyl, *N*-*o*-tolyl- and *N*-*p*-tolylacetimino-ethyl, *N*-phenyl-benzimino-methyl and -ethyl, *N*-*o*-tolyl- and *N*-*p*-tolylbenzimino-methyl

and -ethyl, *N*-methylbenzimino-methyl and -ethyl, *N*-ethylbenzimino-methyl and -ethyl, and *N*-benzylbenzimino-methyl and -ethyl.

Isomerisation occurs more readily with the methyl than with the ethyl compounds, the former, for the most part, undergoing rearrangement at 100°, a temperature at which there is very little change with the latter. The ease of transformation also depends on the orientation of the aryl group attached to nitrogen, *p*-tolyl changing more easily than *o*-tolyl compounds.

The following substituted amides which result from the isomeric change do not appear to have been previously described. *Benzmethyl-o-tolylamide* (m. p. 65—66°) crystallises in prisms from ether and light petroleum. *Benzethyl-o-tolylamide* melts at 71—72°. *Benzmethyl-p-tolylamide* and *benzethyl-p-tolylamide* form prisms melting at 46—48° and 38—40° respectively. *Benzmethylbenzylamide* and *benzethylbenzylamide* are liquids boiling respectively at 213—214° (11 mm.) and 214—216° (12 mm.).

The rearrangement by heat occurs far less readily. *N*-Phenylacetimino-methyl ether undergoes partial isomerisation on prolonged boiling, and considerable isomeric change of *N*-methylbenzimino-methyl ether was obtained after 9 hours heating at 250—270°. With *N*-phenylbenzimino-methyl ether (*Ber.*, 1900, **33**, 1470), less conclusive results were got. With ethyl-imino-ethers, the main change produced by prolonged heating is the elimination of ethylene and regeneration of the parent amide. It is therefore doubtful whether the isomerisation can be caused by simple heating.

Attention was drawn to the formation of ethyl paracyanoformate, $(CN\cdot CO_2Et)_x$, from diethyl imino-oxalate, $HN{:}C(OEt)CO_2Et$, by loss of alcohol and subsequent polymerisation.

Discussion.

Dr. Orton asked whether Dr. Lander had brought about the isomeric change of an *O*-iminoether into the *N*-alkyl compound by use of an alkyl iodide, in which the alkyl group was not identical with the alkyl group of the iminoether. If the first stage of the change is the formation of an additive product of the alkyl iodide and the iminoether, then, if sufficient quantity of the alkyl iodide be used, a *N*-alkyl derivative should be obtained, which would possess the alkyl group of the alkyl iodide, and not that originally present in the *O*-iminoether.

Dr. Lander in reply stated that he had performed an experiment in which the catalytic action of normal propyl iodide (1 mol.) on a methyliminoether had been found to yield chiefly substituted methylamide, the corresponding propyl compound being also produced, but to a

less extent, the trace of methyl iodide first formed proving more effective than the relatively large amount of higher iodide also present.

*25. "The nature and probable mechanism of the replacement of metallic by organic radicles in tautomeric compounds." By G. D. Lander.

The results of the alkylation of keto-enolic compounds and substituted amides by means of dry silver oxide and alkyl iodides (*Trans.*, 1900, 77, 729; 1901, 79, 690; 1902, 81, 591; *Proc.*, 1901, 17, 59) were discussed in the light of the addition hypothesis and its modifications, and also with reference to the views on the mechanism of the replacement of metallic radicles in tautomeric compounds as developed by Wislicenus (Tautomerie, *Ahrens-Sammlung*, 1897, 249). The opinion was advanced that none of these hypotheses is competent to give a perfectly general elucidation of the phenomena, and an explanation was therefore sought in the hypothesis of the display of tautomeric relationships by the compounds containing metallic radicles.

In order to test the validity of silver oxide alkylation as a basis for the discussion of the mechanism of this replacement of metallic radicles, the alkylation of ethyl oxaloacetate and formophenylamide by this method was investigated; the former yields ethyl ethoxyfumarate on treatment with silver oxide and ethyl iodide, a result agreeing with that obtained by Nef (*Annalen*, 1893, 277, 73); the latter, on methylation with silver oxide, gives chiefly *N*-phenylforminomethyl ether, NPh:CH·OMe, together with small amounts of formophenylmethylamide, CHO·NMePh, and diphenylformamidine. The production of the last two substances does not appear to have been noted in the methylation of silver formophenylamide by Comstock and Kleeberg (*Amer. Chem. J.*, 1891, 13, 514), but a control experiment showed that both are formed in their process to a somewhat greater extent than by the silver oxide methylation.

Methylation of the substituted amides by means of silver oxide leads to the formation of mixtures of imino-ethers and isomeric substituted amides, ethylation of these amides under similar conditions apparently gives rise exclusively to imino-ethers. When, however, the ethylation of acetophenylamide by means of silver oxide is conducted in a closed vessel at 100°, *N*-phenylacetiminoethyl ether, NPh:CMe·OEt, and the isomeric amide, NEtPh·CMeO, are both produced just as isomerides are formed in the methylation of the same amide in open vessels at the ordinary temperature or at 40—50°.

N-Phenylbenziminomethyl ether, NPh:CPh·OMe, does not undergo isomeric change when boiled in benzene solution for 4 hours with dry silver oxide and methyl iodide.

***26. "The chlorine derivatives of pyridine. Part VIII. The interaction of 2:3:4:5-tetrachloropyridine with ethyl sodiomalonate." By W. J. Sell and F. W. Dootson.**

The chief product of the interaction of 2:3:4:5-tetrachloropyridine and ethyl sodiomalonate is ethyl 2:3:5-trichloropyridyl-4-malonate which, on hydrolysis, loses carbon dioxide yielding 2:3:5-trichloropyridyl-4-acetic acid. The latter compound is non-volatile, and when heated a little beyond its melting point, is quantitatively decomposed into 2:3:5-trichloro-4-methylpyridine and carbon dioxide. On oxidation with potassium permanganate, 2:3:5-trichloro-4-methylpyridine yields the corresponding acid. These changes may be thus represented:

$$C_5NHCl_3\cdot CH(CO_2Et)_2 \longrightarrow C_5NHCl_3\cdot CH_2\cdot CO_2Et \longrightarrow C_5NHCl_3\cdot Me \longrightarrow C_5NHCl_3\cdot CO_2H.$$

***27. "The biological method for resolving inactive acids into their optically active components." By A. McKenzie and A. Harden.**

In much of the research in this field, no attempt has been made to work with pure cultures. Hence, although the optically active products desired in certain cases were successfully obtained, there is often doubt as to the exact organism by which the resolution had actually been effected, the object having been to obtain the pure active isomeride rather than to examine the action of any particular organism on the inactive acid, and therefore many resolutions ascribed to *Penicillium glaucum* have probably been accomplished, not by that mould, but by bacteria with which the solution under investigation had accidentally become contaminated (compare Landolt, *Das optische Drehungsvermögen*, 1898, 63).

The authors have investigated the action of *Penicillium glaucum*, Link; *Sterigmatocystis nigra*, van Tieghem (= *Aspergillus niger*, van Tieghem, *olim*); and *Aspergillus griseus*, Link, and their action on racemic, dimethoxysuccinic, lactic, α-ethoxypropionic, α-propoxypropionic, α-hydroxybutyric, β-hydroxybutyric, glyceric, malic, methoxysuccinic, ethoxysuccinic, propoxysuccinic, mandelic, methoxyphenylacetic, ethoxyphenylacetic, propoxyphenylacetic, α-bromopropionic, α-bromobutyric, chlorophenylacetic, and monobromosuccinic acids and alanine were investigated.

Their experiments tend to show that the mode of action of the moulds is such that the one active isomeride is attacked more readily than the other, and that the extent of the resolution depends solely on the difference of this rate of attack. The view generally held, namely, that the one isomeride is attacked whilst the other remains

untouched, does not appear to be correct. Two other points were kept in view, firstly, whether, from the action of organisms, any definite relationship could be established as to the configuration of the various related acids, and, secondly, whether the active products of the action of different organisms on the same series of acids show any regularity as to sign of rotation.

28. "Colour changes observed in solutions of cobalt chloride." By W. N. Hartley.

A paper by Donnan and Bassett (*Trans.*, 1902, 81, 939) contains a reference to some work on the action of heat on the absorption spectra and chemical constitution of saline solutions, and to this (*Sci. Trans. Roy. Dubl. Soc.*, 1900, [vii], 253) the author takes exception as being misleading in certain important particulars.

The characteristic spectra of aqueous solutions of cobalt chloride saturated at 20°, as seen in wedge-shaped cells at temperatures between 23° and 93°, differ from those of the hydrochloric acid solution; the compound formed at 93—100° in neutral solutions seems to be the dihydrate, $CoCl_2,2H_2O$, and not the anhydrous salt.

The solution in hydrochloric acid probably contains a compound of the salt with the acid, for the spectrum is peculiar, and, moreover, the anhydrous salt, which is insoluble in dry ether, dissolves in this medium when the mixture is treated with carefully dried hydrogen chloride.

Pure cobalt sulphate may be heated to 300° without perceptible change, and does not alter at a temperature approaching 800°.

Zinc chloride added to a solution of cobalt chloride prevents the development of the blue coloration on warming; this action may be explained by assuming the formation of a double chloride which does not give rise to the dihydrate. The changes produced by mercuric chloride on an alcoholic solution of cobalt chloride are due to the formation of the double cobalt mercuric chloride (Claudet's salt), a substance which in the solid state is particularly sensitive to changes of temperature. If the blue solution observed by Donnan and Bassett during the electrolysis of cobalt chloride is due to the formation at the anode of a complex ion, it should be possible to separate and analyse solutions containing these ions and so determine the ratio of cobalt to chlorine.

The hypothesis that hydrated salts can exist in highly concentrated solutions and can undergo dissociation on raising the temperature accounts precisely for the phenomena observed not only in the case of cobalt chloride but also in that of its iodide, bromide, and the salts of other metals.

29. "The action of ammonia and organic bases on ethyl esters of olefinedicarboxylic and olefine-β-ketocarboxylic acids." By S. Ruhemann.

Ethyl benzylidenemalonate condenses with benzamidine to form *ethyl dihydrodiphenylpyrimidonecarboxylate* (m. p. 188°) according to the equation: $CHPh{:}C(CO_2Et)_2 + CPh(NH_2){:}NH =$

$$CHPh\langle\begin{matrix}CH(CO_2Et)\cdot CO\\ NH\text{———}CPh\end{matrix}\rangle N + C_2H_6O.$$

When this compound is treated with ammonia, the ring opens and then closes, with the loss of carbon dioxide and alcohol, forming *dihydrodiphenylpyrimidone* (m. p. 180°), $CHPh\langle\begin{matrix}CH_2\text{—}CO\\ NH\cdot CPh\end{matrix}\rangle N$, which is also formed by the action of benzamidine on ethyl benzylideneacetoacetate in accordance with the following equation:

$$CH_3\cdot CO\cdot C(CO_2Et){:}CHPh + CPh(NH_2){:}NH + C_2H_6O =$$

$$CH_2\langle\begin{matrix}CO_2Et & NH\\ CHPh\text{—}NH\end{matrix}\rangle CPh + CH_3\cdot CO_2Et =$$

$$CH_2\langle\begin{matrix}CO\text{———}N\\ CHPh\cdot NH\end{matrix}\rangle CPh + CH_3\cdot CO_2Et + C_2H_6O.$$

In studying the action of ammonia on ethyl esters of olefine-β-ketocarboxylic acids, it was found that both ethyl ethylideneacetoacetate and ethyl furylideneacetoacetate are transformed by ammonia into ethyl hydrocollidinedicarboxylate and ethyl hydrofuryllutidinedicarboxylate respectively. The formation of these compounds depends on the previous decomposition of the ethyl olefine-β-ketocarboxylic ester into ethyl acetoacetate and the aldehyde ammonias, which, in turn, condense to form the hydrogenised pyridine derivatives.

Ethyl benzylideneacetoacetate, $CH_3\cdot CO\cdot C(CO_2Et){:}CHPh$, behaves differently towards ammonia and yields *benzylideneaminoacetone*, $CH_3\cdot CO\cdot C(NH_2){:}CH\cdot C_6H_5$ (colourless needles, m. p. 125°). This substance, on heating with acids, readily loses benzaldehyde. On carefully warming the ketone with concentrated hydrochloric acid, an insoluble chloride is produced which may be regarded as diacetobenzylideneimide hydrochloride, $NH(CAc{:}CHPh)_2,HCl$.

30. "Derivatives of *p*-aminoacetophenone." By F. D. Chattaway.

In the course of a study of the transformation of diacetanilide into aceto-*p*-aminoacetophenone under the influence of hydrogen chloride or of zinc chloride, the following compounds have been prepared. They are formed by the ordinary processes, but in the preparation of the nitrogen-halogen derivatives great care must be taken

to avoid the liberation of free halogen, otherwise substitution in the ketonic chain occurs.

p-*Acetylchloroaminoacetophenone*, $C_6H_4Ac{\cdot}NAcCl$, colourless, pearly plates, readily soluble in chloroform, m. p. 72°; p-*acetylbromoaminoacetophenone*, $C_6H_4Ac{\cdot}NAcBr$, yellow, rhombic plates, m. p. 83°; p-*propionylaminoacetophenone*, $C_6H_4Ac{\cdot}NH{\cdot}COEt$, colourless prisms, m. p. 136°; p-*propionylchloroaminoacetophenone*, $C_6H_4Ac{\cdot}N(COEt)Cl$, colourless plates, m. p. 42°; p-*benzoylaminoacetophenone*, $C_6H_4Ac{\cdot}NH{\cdot}COPh$, thin, colourless plates, m. p. 205°; p-*benzoylchloroaminoacetophenone*, $C_6H_4Ac{\cdot}N(COPh)Cl$, colourless plates, m. p. 77°.

On heating, the nitrogen-halogen derivatives undergo transformation with considerable decomposition; when dissolved and warmed in acetic acid, halogen passes from the nitrogen into the ortho-position in the nucleus, whilst, if free halogen is liberated, substitution in the methyl group of the ketone also takes place.

ADDITIONS TO THE LIBRARY.

II *By Purchase.*

Herzberg, Wilhelm. Papierprüfung. Eine Anleitung zum Untersuchen von Papier. 2nd ed. ill. Berlin 1902.

Koenigsberger, Leo. Hermann von Helmholtz. Vol. I. With 3 portraits. Braunschweig 1902.

Vaubel, Wilhelm. Lehrbuch der theoretischen Chemie. Vol. I. Materie und Energie—Molekül und Lösung. Vol. II. Zustandsänderungen und chemische Umsetzungen. ill. Berlin 1903.

Borchers, William. Elektro-Metallurgie. Die Gewinnung der Metalle unter Vermittlung des elektrischen Stromes. 3rd ed. Part I. ill. Leipzig 1902.

Höber, Rudolf. Physikalische Chemie der Zelle und der Gewebe. ill. Leipzig 1902.

Hofmann, Karl. Die radioactiven Stoffe nach dem gegenwärtigen Stande der wissenschaftlichen Erkenntnis. Leipzig 1903.

Zellner, Julius. Die künstlichen Kohlen für elektrotechnische und elektrochemische Zwecke, ihre Herstellung und Prüfung. ill. Berlin 1903.

Naske, Carl. Die Portland-Cement-Fabrikation. Ein Handbuch für Ingenieure und Cementfabrikanten. ill. Leipzig 1903.

ANNIVERSARY DINNER.

It has been arranged that the Fellows of the Society and their friends shall dine together at the Whitehall Rooms, Hotel Métropole, at 6.30 for 7 o'clock, on **Wednesday, March 25th, 1903** (the day fixed for the Annual General Meeting).

The price of the tickets will be One Guinea each, including wine.

All applications for tickets must be received not later than **Wednesday, March 18th.**

Tickets will be forwarded to Fellows on receipt of a remittance for the number of tickets required, addressed to the Assistant Secretary, Chemical Society, Burlington House, W.

ANNUAL GENERAL MEETING.

The Annual General Meeting of the Society for the Election of Officers and other business will be held on **Wednesday,** March 25th, at **half past four** o'clock in the afternoon.

At the next meeting, on **Thursday, March 5th, 1903, at 8** p.m., the following papers will be communicated:

"The mechanism of the reduction of potassium dichromate by sulphurous acid." By H. Bassett.

"The constitution of pilocarpine. Part IV." By H. A. D. Jowett.

"Preparation and properties of 1 : 4-(or 1 : 5)-dimethylglyoxaline, and 1 : 3-dimethylpyrazole." By H. A. D. Jowett and C. E. Potter.

"Some analyses of "Reh," or the alkaline salts in Indian usar land." By E. G. Hill.

"Experiments on the synthesis of camphoric acid. Part III. Synthesis of *iso*lauronolic acid." By W. H. Perkin, jun., and J. F. Thorpe.

"Camphor-β-thiol." By T. M. Lowry and G. C. Donington.

"Isomeric change of dibenzanilide into benzoyl-*o*-amino- and benzoyl-*p*-amino-benzophenones." By F. D. Chattaway.

"The rate of decomposition of diazo-compounds. Part III. The temperature-coefficient." By J. C. Cain and F. Nicoll.

RICHARD CLAY AND SONS, LIMITED LONDON AND BUNGAY.

Issued 14/3/03

PROCEEDINGS

OF THE

CHEMICAL SOCIETY.

Vol. 19. No. 262.

Thursday, March 5th, 1903. Dr. W. H. PERKIN, F.R.S., Vice-President, in the Chair.

Messrs. Brincker, Howorth, Beanes, J. E. Mackenzie, Cousins, and Desch were formally admitted Fellows of the Society.

The lists of names of the Officers and Council proposed for Election by the Council were read from the Chair.

Certificates were read for the first time in favour of Messrs.

Henry Guest Adshead, Heysham, Wimbledon Park, Wimbledon.
Harford Montgomery Atkinson, 32, Bagnall Road, Milton.
George Neville Blackshaw, Agricultural College, Aspatria.
Harry T. Calvert, D.Sc., West Riding of Yorkshire Rivers Board.
Ben Caudwell, B.A., 28, Wigfull Road, Sheffield.
Alan Fletcher, 132, Holland Road, Kensington, W.
Arthur Ernest Pitt, 66, Abbot Road, Bromley, E.
Harold Russell Pitt, 8, Church Lane, Charlton, S.E.
Frederick Robertson, The Hewan, Bearsden, Glasgow.
Fitzroy Owen Jonathan Roose, Oxford Road, Bournemouth.
Henry Edward Stevenson, 5, Turner's Road, Bow, London, E.
James Bates Wilkinson, M.D., Town Hall, Oldham.

Of the following papers those marked * were read :—

*31. "The mechanism of the reduction of potassium bichromate by sulphurous acid." By H. Bassett, jun.

Berthier, who investigated the action of sulphur dioxide on solutions of potassium bichromate and potassium chromate (*Ann. Chim. Phys.*, 1843, [iii], 7, 77), stated that in both cases a mixture of sulphate and dithionate was formed, but without giving details.

The reaction has now been studied more fully, and the results show that 94—95 per cent. of sulphate and 5—6 per cent. of dithionate are formed, when potassium bichromate, potassium chromate, or chromic acid is reduced by sulphurous acid; the amount of dithionate produced being independent of the temperature.

Solutions containing known amounts of sulphurous acid and potassium bichromate were mixed, and the excess of sulphurous acid estimated with iodine and sodium thiosulphate, or the excess of chromate determined by means of ferrous ammonium sulphate.

The freshly reduced solutions do not give the reactions of either chromium or SO_4, and seem to contain a compound $\left.\begin{matrix}KSO_3\\KSO_4\end{matrix}\right\rangle Cr_2(SO_4)_2$ (or the corresponding acid), which slowly decomposes into $Cr_2(SO_4)_3$ and K_2SO_3.

When sulphuric acid or potassium sulphate is added to these solutions, it enters into combination in such a way that the reactions of SO_4 are not given by the resulting mixture, and as many as 6 mols. of sulphuric acid may be taken up by 1 mol. of chromium sulphate.

Electrolytic experiments show that the green solutions contain a green anion which slowly decomposes into violet chromium and SO_4 ions.

*32. "The constitution of pilocarpine. Part IV." By H. A. D. Jowett.

The author showed that the constitutional formula for pilocarpine, suggested by Pinner and Schwarz, is only one of several equally probable on the results hitherto recorded.

The constitution of *iso*pilocarpine has, however, been determined by a study of the reactions of dimethylglyoxaline and dimethylpyrazole and by the formation of 1-methylglyoxaline, 1 : 4(or 1 : 5)-dimethylglyoxaline, 1 : 4(or 1 : 5)-methylamylglyoxaline, and probably 1 : 4

(or 1 : 5)-methylamyleneglyoxaline, together with ammonia and methylamine, when the alkaloid is distilled with soda-lime.

Dimethylglyoxaline, from *iso*pilocarpine, boiled at 210—215° and formed crystalline salts; *platinichloride*, m. p. 238—239°; *aurichloride*, m. p. 214—215°; *picrate*, m. p. 167°. It is isomeric and not identical with the dimethylglyoxalines described in the following note. On oxidation, it yields ammonia, methylamine, and acetic acid.

Methylamylglyoxaline, from *iso*pilocarpine, boiled at 158—160° under 10 mm. pressure; *platinichloride*, m. p. 198°; *picrate*, m. p. 134°; *aurichloride*, amorphous. On oxidation, this base yielded ammonia, methylamine, and *n*-hexoic acid.

Methylamyleneglyoxaline, which probably exists in the fraction boiling at 145—160° under 10 mm. pressure, was not isolated; its presence was inferred from the formation of butyric acid during oxidation.

*iso*Pilocarpinolactone, on oxidation with permanganate, yielded ammonia, methylamine, and pilopic acid, whilst pilocarpine gave rise to ammonia, methylamine, and homopilopic acid.

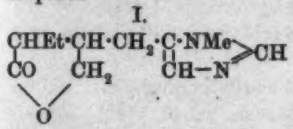
*iso*Pilocarpine, which could not be reduced electrolytically, did not form diacidic salts, and on titration behaved as a normal lactone.

*iso*Pilocarpine methiodide, with picric acid, yielded the compound previously described as methyl*iso*pilocarpine picrate, but which should be termed *iso*pilocarpine methyl picrate.

The absorption spectra of pilocarpine and *iso*pilocarpine, kindly determined by Prof. J. J. Dobbie, were absolutely identical.

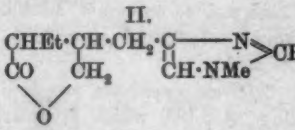
The following formulæ were proposed for pilocarpine and *iso*pilocarpine:

I.



or

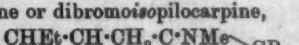
II.



and it was suggested that pilocarpine and *iso*pilocarpine are stereoisomerides, the asymmetric carbon atom involved being that contiguous to the carboxyl residue.

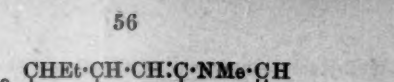
The following configurations were proposed on the basis of formula I:

Dibromopilocarpine or dibromo*iso*pilocarpine,



Dibromo*iso*pilocarpinic acid,

*iso*Pilocarpinolactone,

*iso*Pilocarpinic acid, 

Bromocarpinic acid, $CO_2H{\cdot}CHEt{\cdot}CH_2{\cdot}CH{:}CH{\cdot}NMe{\cdot}CBr{:}N{\cdot}CO_2H$.

It was shown that the explanation given by Pinner and Schwarz of the formation of pilocarpoic acid, $C_{11}H_{16}O_5N_2$, is quite untenable, but no suggestions as to the constitution of this substance or pilomalic acid were offered.

***33. "Preparation and properties of 1 : 4(or 1 : 5)-dimethylglyoxaline and 1 : 3-dimethylpyrazole." By H. A. D. Jowett and C. E. Potter.**

These bases were prepared in order to compare their reactions with those of *iso*pilocarpine.

1 : 4(or 1 : 5)-*Dimethylglyoxaline*, obtained from 4(or 5)-methylglyoxaline (hitherto described as a liquid, but now obtained in crystals, m. p. 55°), is an oil boiling at 203° and forming an *aurichloride*, m. p. 215°; *platinichloride*, m. p. 239°; *picrate*, m. p. 167°; *methiodide*, m. p. 156°; and *hydrochloride*, m. p. 145°. Bromine gave a crystalline *dibromo*-derivative, m. p. 127°, but at 100° under pressure the reaction was complicated and a crystalline acid was produced. On oxidation, the base yielded ammonia, methylamine, and acetic acid, whilst by the action of potassium hydroxide the methiodide gave methylamine and acetic acid.

1 : 3-*Dimethylpyrazole*, prepared from 3-methylpyrazole, is a liquid boiling at 148°, which gives an *aurichloride*, m. p. 175°; *platinichloride*, m. p. 234°; *hydrochloride*, m. p. 160°; and *methiodide*, m. p. 256°. Bromine under ordinary conditions, or at 100° under pressure, gave a *dibromo*-derivative, m. p. 74°; 1-*methylpyrazole*-3-*carboxylic acid*, m. p. 222°, was obtained by oxidation of the base. The methiodide was scarcely attacked by potassium hydroxide.

Prof. C. R. Marshall states that these bases have no physiological action analogous to that of pilocarpine.

1 : 2-Dimethylglyoxaline forms a *picrate*, m. p. 179°; an *aurichloride*, m. p. 215°; a *platinichloride*, m. p. 230°; and a *methiodide* which does not melt below 300°.

***34. "Camphor-β-thiol." By T. M. Lowry and G. C. Donington.**

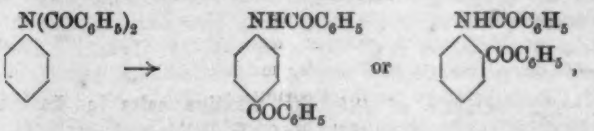
Camphor-β-thiol, $HS{\cdot}C_8H_{13}{<}\begin{matrix}CH_2\\CO\end{matrix}$, prepared by reducing the sulphochloride of Reychler's camphorsulphonic acid, is a colourless solid, of characteristic and not unpleasant odour, readily volatile with steam, which crystallises from alcohol in small, glistening prisms and melts at 66°; $[\alpha]_D = +6°$ (in acetone). It is insoluble in alkalis but forms a lead salt and a mercurichloride, $ClHg{\cdot}S{\cdot}C_{10}H_{15}O$. The disulphide melts at 224°; $[\alpha]_D = -90°$ (in acetone). The acetate, $AcS{\cdot}C_{10}H_{15}O$, forms needle-shaped crystals melting at 38°; $[\alpha]_D^{17} = -41°$ (in acetone). The benzoate, $BzS{\cdot}C_{10}H_{15}O$, melts at 59°; $[\alpha]_D^{17} = -16°$ (in acetone).

***35. "Isomeric change of dibenzanilide into benzoyl-o-amino- and benzoyl-p-amino-benzophenones." By F. D. Chattaway.**

The author has previously shown (*Proc.*, 1902, 18, 173) that acyl groups must be included among those which, under suitable circumstances, can pass from the nitrogen of an aromatic amine into the nucleus.

From the product of the isomeric change of diacetanilide at a high temperature, only that isomeride in which the acyl group has taken up the para-position can be isolated in quantity, although the ortho-compound is undoubtedly formed.

The transformation of dibenzanilide, however, is precisely analogous to others of the same type, and both the ortho- and the para-derivatives can be easily isolated. The isomeric change,



which takes place readily under the influence of hydrogen chloride, is best effected by heating aniline (1 mol.) with benzoyl chloride (2 mols.) for 18 to 20 hours at about 220°.

The product is hydrolysed by alcoholic hydrochloric acid, and the alcohol driven off in a current of steam. On adding water, the bases, which remain in solution as hydrochlorides, can be separated from tarry matters, and any unchanged aniline removed by making the solution alkaline with sodium hydroxide and distilling in steam. On cooling, the other bases solidify, and on dissolving the dry product in a little

alcohol and adding a slight excess of strong sulphuric acid, the sparingly soluble sulphate of *p*-aminobenzophenone crystallises out. On making the mother liquor alkaline and distilling in superheated steam, *o*-aminobenzophenone slowly distils over and crystallises from the distillate in a pure state.

About 45 grams of *p*-aminobenzophenone and 15 grams of *o*-aminobenzophenone can be obtained from 100 grams of aniline.

***36. "Formation of purpurogallin by the electrolytic oxidation of pyrogallol." By A. G. Perkin and F. M. Perkin.**

The methods hitherto employed for the production of purpurogallin give only a poor yield, but recent experiments made by the authors on the electrolytic oxidation of pyrogallol have shown that, in general, the quantity of purified product amounts to 37—45 per cent. of the calculated amount. The purified substance, which had all the properties of purpurogallin, and its acetyl derivative, gave, on analysis, figures which established its identity with this colouring matter.

The composition of the electrolytic bath has been frequently varied, and recently a solution containing 28 grams of pyrogallol, 10 c.c. *N*-sulphuric acid solution, and 50 grams of sodium sulphate in 500 c.c. of water has been found to be most effective. The best results have been obtained by using a rapidly rotating anode of platinum-iridium and a cathode of lead or graphite. The current density was 4—6 amperes with an *E.M.F.* of 8—10 volts. The behaviour of other phenolic substances under similar conditions is now under investigation. Gallic acid yields a small quantity of a product which probably contains the purpurogallincarboxylic acid recently described (*Trans.*, 1903, 83, 199).

37. "The analysis of *Reh*, the alkaline salts in Indian *usar* land." By E. G. Hill.

The upland barren lands of India, extending over an area of about two million acres, which are mainly found between the Jumna and the Ganges, and also between the latter and the Gogra, contain so large a quantity of soluble salts in the soil that agriculture is practically impossible. The reclamation of this land has occupied the attention of the Government of India for many years, but less effort has been made to utilise the soluble salts. Such lands have the following general features:

the soil is impermeable for a varying depth below the first few inches; below the impermeable layer is a coarser layer, more or less porous, in which nodular limestone is generally found, and this is sometimes so thick and continuous as practically to form a rock. The upper soil is thus shallow and fitted for the concentration of soluble salts. Such land varies in appearance according to its humidity and the amount of salts which it contains. Efflorescence is frequent, and a grey colour is general. An account of the various attempts which have been made to utilise *usar* land has been published in the Indian Agricultural Ledger (1901, No. 13) by W. H. Moreland, but analyses of the soluble salts contained in these soils have not been recorded, and no attempts have been made to extract these substances and employ them on a large scale. Out of the samples analysed, none contained less than 88 or 89 per cent. of sodium carbonate, but the percentage of salt in the soil varies very materially according to the district and the sub-soil. In the districts where there is a considerable quantity of alkali in the soil, the upper layers are collected and sold under the name of *sŭjji mŭttee*. This is used by native washermen in place of soap, and in Allahabad one tradesman makes a crude soap by boiling the solution of this earth with lime and castor oil.

Glass has also been made from this sodium carbonate, the chief product being the glass bangles which are so common in the country; sodium hydroxide has also repaid its manufacture, especially in the vicinity of paper mills. Both sodium carbonate and sodium hydroxide are, however, largely imported into India; the former, especially, being employed in the aëration of mineral waters.

It was thought that *reh* might be interesting from a chemical point of view, and it was examined in order to ascertain whether any sodium sesquicarbonate was present, since this substance occurs in other parts of the world as the native carbonates, *trona* and *urao*.

Each sample of earth was digested with hot water several times and the solution filtered. In each case, the light brown solution thus obtained yielded on evaporation large and well-defined crystals of the decahydrated normal carbonate, but fractional crystallisation gave a few monoclinic crystals imbedded in the solid mass produced by slowly evaporating the third fraction. These became opaque on being scratched and were possibly efflorescent.

The solution, which contained a considerable amount of humus, was evaporated to dryness on the water-bath, the residue being freely powdered and dried in a steam oven until the weight was constant. This was a long and tedious process; the weight diminished steadily for 48 hours, although less than half a gram of the substance was taken. There is therefore probably some hydrogen carbonate in the

soluble salts. When the weight was constant, a combustion was made with the following result:

0·3892 gram gave 0·0278 CO_2 and 0·0078 H_2O with a residue of 0·3584 Na_2CO_3.

The loss in the dried sample was thus 0·0308 gram, or approximately 8 per cent., a result which was confirmed by igniting other portions of the dried salt in a weighed crucible.

Assuming that humus is half the weight of the CO_2 derived from it, and that the difference between the gain in the absorption tubes and loss in the combustion boat is due to oxidation of humus, we get 0·0048 gram of humus or 0·0096 gram of CO_2 due to humus. This leaves 0·0182 gram of CO_2 due to the decomposition of sesquicarbonate at red heat.

The corresponding quantity of sesquicarbonate is 0·1133, which would yield 0·0075 gram of water. The water found was 0·0078 gram. Hence the dried salt contained 29·9 per cent. of sesquicarbonate. The above experiments were made with the Pertabgarh sample.

The soluble salts in five samples from different districts were analysed with the following results:

District.	Pertabgarh.	Benares.	Mirzapur.	Allahabad trans-Ganges.	Allahabad trans-Jumna.
Percentage of soluble salts.	6·3	3·1	16·6	6·3	6·5
Na_2O	57·70	57·72	56·70	57·60	57·61
CO_2	39·72	39·40	36·97	39·17	39·33
Al_2O_3	0·31	0·12	0·12	trace	trace
SO_3	—	—	5·26	2·32	1·71
Cl	2·06	2·67	0·73	0·77	1·06
P_2O_5	0·56	0·45	0·38	0·35	0·64
	100·35	100·36	100·16	100·21	100·37

There were slight traces of silica and lime in each sample. These analyses indicate that the five samples have the following percentage compositions:

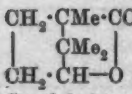
District.	Pertabgarh.	Benares.	Mirzapur.	Allahabad trans-Ganges.	Allahabad trans-Jumna.
Percentage of soluble salts.	6·3	3·1	16·6	6·3	6·5
Na_2CO_3	95·63	95·08	88·90	94·38	94·80
NaCl	3·39	4·40	1·20	1·21	1·75
Na_2SO_4	—	—	9·34	4·12	3·02
P_2O_5, Al_2O_3	as	above			

38. "Experiments on the synthesis of camphoric acid. Part III. Synthesis of *iso*lauronolic acid." By W. H. Perkin, jun., and J. F. Thorpe.

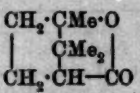
When ethyl cyanodimethylsuccinate, $CO_2Et\cdot CMe_2\cdot CH(CN)\cdot CO_2Et$, prepared by treating the sodium compound of ethyl cyanoacetate with ethyl bromo*iso*butyrate, is digested with sodium ethoxide and ethyl β-iodopropionate in alcoholic solution, *ethyl cyanodimethylbutanetricarboxylate*, $CO_2Et\cdot C(CN)<\begin{matrix}CH_2\cdot CH_2\cdot CO_2Et\\ CMe_2\text{——}CO_2Et\end{matrix}$, is obtained as an oil which distils at 210—215° under 13 mm. pressure.

On hydrolysis with dilute sulphuric acid, this ester is converted into *dimethylbutanetricarboxylic acid*, $CO_2H\cdot CH<\begin{matrix}CH_2\cdot CH_2\cdot CO_2H\ (a)\\ CMe_2\text{——}CO_2H\ (b)\end{matrix}$, a colourless, crystalline substance which melts at 155—157°.

When the trisodium salt of this acid is digested with acetic anhydride, carbon dioxide and water are eliminated between the two carboxyl groups (*a*) and (*b*), and *ketodimethylpentamethylenecarboxylic acid*, $CO_2H\cdot CH<\begin{matrix}CH_2\text{—}CH_2\\ CMe_2\cdot CO\end{matrix}$, is formed. This acid crystallises well, melts at 110°, yields an ethyl ester distilling at 172° (100 mm.), and a semicarbazone melting at 217°. The ethyl ester, when treated with magnesium methyl iodide in ethereal solution, is converted into a lactone which distils at 155—157° (50 mm.) and has a most penetrating odour of peppermint. This new lactone, for which the name *isocampholactone* is proposed, is isomeric with campholactone, and the close relationship which exists between these two substances is obvious when their formulæ are written side by side:



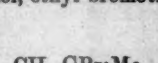
Campholactone.



iso*Campholactone.*

The above formation of *iso*campholactone constitutes the first synthesis of that trimethylpentamethylene ring which is the basis of camphoric acid and of so many other substances belonging to the camphor group, and it is hoped that it may ultimately be possible to obtain camphoric acid itself from this lactone.

When the lactone is treated with phosphorus pentabromide and the product poured into alcohol, ethyl bromotrimethylpentamethylenecarboxylate is formed:



and is an oil which distils at 165—170° under 70 mm. pressure.

In an experiment in which this bromo-ester was heated with potassium cyanide in alcoholic solution, and then with alcoholic potash, a quantity of an oily acid was obtained which was obviously inactive α-campholytic acid, produced from the bromo-ester by elimination of hydrogen bromide and subsequent hydrolysis. This was proved by the fact that, on distillation with dilute sulphuric acid, the oil was converted into a crystalline acid melting at 132°, which, on examination, was easily identified as iso*lauronolic acid*, the well-known isomeric change indicated by the formulæ:

α-*Campholytic acid.* iso*Lauronolic acid.*

having taken place.

That the *iso*lauronolic acid, thus synthesised, is identical with *iso*lauronolic acid obtained from camphoric acid was shown by mixing equal quantities of the two preparations, when the mixture melted at 132°, the melting point of the constituents. Furthermore, the synthetical acid, on oxidation with permanganate, yielded *iso*lauronic acid.

39. "The rate of decomposition of diazo-compounds. Part III. The temperature-coefficient." By J. C. Cain and F. Nicoll.

The authors have determined the temperature-coefficients by the use of Arrhenius's formula,

$$C_{t_1} = C_{t_0} e^{A(T_1 - T_0) : T_1 T_0},$$

the values of C being calculated from the formula

$$\frac{1}{t} \log \frac{A}{A - x} = C,$$

as indicated in their earlier communications (*Trans.*, 1902, **81**, 1412; 1903, **83**, 206).

The values of A for diazobenzene-*p*-sulphonic acid and the chlorides of diazobenzene, diazo-*o*-toluene, diazo-*m*-toluene, diazo-*p*-toluene, and diazo-*m*-nitrobenzene do not vary much from each other, and agree with those found by Euler (*Annalen*, 1902, 325, 301) for diazobenzene chloride (11905) and diazo-*p*-bromobenzene chloride (13634). By the use of the temperature-coefficients thus obtained, the value of C at other temperatures has been calculated in several cases, and shown to be in agreement with the numbers found by other observers.

40. "An analysis of the natural gas at Heathfield, Sussex." By H. B. Dixon and W. A. Bone.

When the possibility of the industrial application of the Heathfield natural gas was brought before the Royal Commission on Coal Supplies, one of the authors (H. B. D., a member of the Commission) was asked to visit Heathfield and examine the nature of the gas on behalf of the Commission. Accordingly, several samples of gas were collected and sealed up in glass tubes on October 10th, 1902, and brought to Owens College for analysis.

According to Mr. Richard Pearson, Managing Director of the "Natural Gas Company," the gas was first discoved in 1836 in a well which was being sunk at Hawkhurst in West Sussex. In the Sub-Wealden boring (1873—1875), the gas was met with at Netherfield on the South Eastern Railway. Gas was first encountered at Heathfield in 1895 in sinking a well for water in the hotel yard, about 50 yards from the station. In 1896, the same firm of well-sinkers met the gas at a depth of 300 feet in a shaft sunk for water at the station; no water was found, but the gas continued to escape, and was then used for lighting the station.

At the date of the above visit, six wells were either sunk or in

course of being sunk, and gas had been encountered in all of them after the bores had penetrated through the 300 or 400 feet of surface bed of sandstone and marl which forms, according to Mr. Pearson, the impervious lid to the natural holder of gas.

The gas was issuing from the bore-holes at a pressure of between 140 and 200 lbs. per square inch, and was being used to drive gas engines and to light (with incandescent mantles) the station and a number of houses in the village. When lighted at an inch pipe at the mouth of a bore-hole, the gas burnt with a large flame giving a fairly good light, the flame being more luminous than that of fire-damp from coal mines. In an argand burner, the gas burnt with a moderately luminous flame, but gave little light in an ordinary bats-wing, so that it was difficult to understand how the gas could contain 5½ per cent. of ethylene, as was stated, unless, indeed, the free oxygen, also said to be present, was sufficient to destroy its lighting power. The analyses, however, showed that neither ethylene nor free oxygen was present in the gas collected. To avoid the possible loss of free oxygen by partial combustion in the tube while the drawn-out ends were being sealed, a sample was collected by closing the ends of the tube with paraffined indiarubber; it gave the same result.

The gas was transferred by means of a Töpler pump from the collecting vessels into small tubes standing over mercury. The analyses were made over mercury in a modified McLeod apparatus, all the reagents being freshly prepared.

A. *Preliminary examination for carbon dioxide, oxygen, unsaturated hydrocarbons, and carbon monoxide.*

(1) The absence of carbon dioxide and oxygen was proved by exposing the gas successively to the action of (*a*) strong potassium hydroxide solution and (*b*) strongly alkaline pyrogallol solution. In neither case was there any appreciable absorption.

(2) The absence of unsaturated hydrocarbons was shown in two separate experiments in which samples of gas were successively treated with (*a*) fuming sulphuric acid and (*b*) strong potassium hydroxide solution. No change in volume occurred in either experiment.

(3) The gas always showed an appreciable contraction (as nearly as possible 1 per cent.) when successively treated with ammoniacal cuprous chloride and dilute sulphuric acid. No precipitate of cuprous acetylide was formed. Since the foregoing experiments exclude the possibility of this contraction being due to oxygen or unsaturated hydrocarbons, it can only be attributed to the presence of carbon monoxide.

B. *Explosion analyses for saturated hydrocarbons, with, possibly, hydrogen, after removal of carbon monoxide.*

After removing the carbon monoxide from a considerable volume of

the gas (by means of ammoniacal cuprous chloride and dilute sulphuric acid), the contraction, C, obtained on exploding measured volumes of the residual gas with a large excess of oxygen and air, was determined, and also the absorption, A, when the products of explosion were subsequently treated with strong potassium hydroxide solution. The following results were obtained:

	1.	2.	3.
Volume of gas taken (corr.).....	48·25	55·70	58·75
Volume of oxygen and air added	457·45	468·30	465·45
C	94·35	109·10	115·20
A	48·25	55·90	58·80
C/A	1·956	1·952	1·959

C. *Proof that the gas does not contain free hydrogen.*

Before the foregoing results could be interpreted, it was necessary to ascertain whether the gas contained free hydrogen. This was done by exposing some of the gas, after removing carbon monoxide, to the action of "oxidised" palladium sponge at 100° for twenty minutes in an apparatus similar to that described by Bone and Jerdan (Trans., 1901, 79, 1044), and afterwards redetermining the ratio C/A, when the residual saturated hydrocarbons were exploded with excess of oxygen and air. The results obtained were as follows:

	4.	5.
Volume of gas taken (corr.)	62·3	55·3
Oxygen and air added.....	472·5	493·0
C	121·8	108·2
A	62·2	55·4
C/A	1·958	1·953

A comparison of these numbers with those given above shows clearly that the gas contains an appreciable quantity of free hydrogen. The five explosion analyses indicated, however, the presence, besides methane, of a small proportion of some higher saturated hydrocarbon which is probably ethane. Assuming this to be the case, the percentage composition of the gas, after removing carbon monoxide, calculated from the five analyses, is as follows:

	1.	2.	3.	4.	5.	Mean.
Methane...	94·10	93·88	94·40	94·30	93·90	94·10
Ethane ...	2·95	3·23	2·77	2·76	3·13	2·97
Nitrogen, by difference.....						2·93
						100·00

The original gas, therefore, had the following composition :

Carbon monoxide	1·00
Methane	93·16
Ethane	2·94
Nitrogen, or other inert gas (by difference)	2·90
	100·00

41. "Chemical composition of cooked vegetable foods." By Miss K. I. Williams.

The following constituents: water; total nitrogen (by Kjeldahl's method, modified to include the nitrogen of nitrates); ash; sulphur; phosphorus; cellulose (by Schulze's potassium chlorate method); woody fibre (by digestion with dilute sulphuric acid); carbohydrates convertible into dextrose; fat; and waste, were estimated in a series of vegetable foods including broccoli, Brussels sprouts, dried peas, oatmeal (coarse Scotch), and macaroni, these determinations being carried out on both the raw and the cooked materials.

42. "The density of nitric oxide. Preliminary notice." By R. W. Gray.

It seemed doubtful whether nitric oxide had been obtained in a state of sufficient purity to admit of the accurate determination of its density and other physical constants. The value obtained by Leduc (*Compt. rend.*, 1893, 116, 322) for the density does not agree absolutely with the value found by Victor Meyer and Daccomo (*Annalen*, 1887, 240, 326), while Olszewski's results (*Compt. rend.*, 1885, 100, 940) for the vapour pressures of the liquefied gas certainly suggest the possibility of impurity in the sample he used.

Nitric oxide, when prepared by many of the usual methods, contains small quantities of nitrous oxide and nitrogen. The higher oxides of nitrogen which are generated at the same time are apparently completely absorbed when passed through tubes containing potassium hydroxide in solution and in the solid form, and the gas then liquefies to a blue liquid which does not change in tint after repeated fractionation. The nitrogen present cannot be entirely removed by solidifying the nitric oxide by means of liquid air and pumping off the uncondensed gas; a small quantity remains behind in the solid nitric oxide and can only be removed by liquefying and allowing a large portion of the liquid to boil away.

Owing to the ease with which liquid nitric oxide becomes super-

heated, it was found impossible to separate by fractionation the nitrous oxide present unless the upper part of the bulb containing the liquefied gas was kept below the melting temperature of solid nitrous oxide. When this was done, the densities of different fractions of the gas were found to agree.

The mean value for the weight of 1 litre of nitric oxide, prepared in two different ways, is 1·3402 grams at 0° and 760 mm. pressure (lat. Paris).

Until confirmed by further experiments, this value is not considered as final, but it is interesting to note that, assuming the truth of Avogadro's law for oxygen and nitric oxide under standard conditions of temperature and pressure, the ratio of the atomic weights so deduced for oxygen and nitrogen is 16 : 14·001.

The work is being continued with the object of making further experiments on the density of this gas and of determining its compressibility and other physical constants.

43. "Hydrolysis of urea hydrochloride." By J. Walker and J. K. Wood.

A comparison method was described which permits the hydrolysis of a salt such as urea hydrochloride to be determined by the catalysis of cane sugar or methyl acetate with an error not exceeding 1 per cent.; the results obtained with these two compounds being identical.

Within the limits 25—40°, temperature has practically no influence on the hydrolysis of urea hydrochloride.

The influence of dilution on the degree of hydrolysis x is expressed by the relation $\frac{x^2}{(1-x)v} = \text{constant}$.

The addition of sodium chloride very slightly diminishes the value of x.

The dissociation constant of urea, calculated from the hydrolytic experiments, is $1{\cdot}5 \times 10^{-14}$ at 25°.

44. "The affinities of some feebly basic substances." By J. K. Wood.

By means of the methyl acetate method, together with some solubility experiments, the author has obtained the following results at 40·2°:

Base.	Percentage hydrolysis of hydrochloride in decinormal solution.	Dissociation constant.	Base.	Percentage hydrolysis of hydrochloride in decinormal solution.	Dissociation constant.
Creatinine	8·96	$3·57 \times 10^{-11}$	Dimethylpyrone	85·0	$0·0065 \times 10^{-11}$
Acetoguanamine..	9·8	2·96 ,,	Xanthine	88·5	0·0046 ,,
Semicarbazide ...	10·4	2·61 ,,	Acetanilide.....	88·9	0·0044 ,,
Glycocyamine ...	11·0	2·32 ,,	Caffeine	89·7	0·0040 ,,
Creatine	12·3	1·81 ,,	Urea	90·4	0·0037 ,,
Guanine	17·9	0·81 ,,	Acetamide	91·3	0·0033 ,,
Acetonesemicarbazone	26·9	0·32 ,,	Nitroguanidine	94·0	0·0021 ,,
Acetoxime	34·3	0·175 ,,	Propionitrile ...	97	—
Aminocaffeine ...	55·0	0·047 ,,	Cyneol.....	98	—
Theobromine	73·0	0·016 ,,	Biuret	>99	—
			Benzamide	>99	—

ADDITIONS TO THE LIBRARY.

I. Donations.

Cohen, Julius Berend. Theoretical organic chemistry. London 1902. From the Author.

Gregory, William. A handbook of inorganic chemistry, being a new and greatly enlarged edition of the "Outlines of inorganic chemistry." 3rd ed. ill. London 1853. From the Lawes Trust.

Lang, H. Das chemische Laboratorium an der Universität in Heidelberg. ill. Carlsruhe 1858. From the Lawes Trust.

Low, David. An inquiry into the nature of the simple bodies of chemistry. 2nd ed. London 1848. From the Lawes Trust.

Marignac, Jean-Charles Galissard de. Œuvres complètes, publiées hors série sous les auspices de la Société de physique et d'histoire naturelle de Genève: par E. Ador. vol. ii. Mémoires et critiques, 1860—1887. Geneva 1903. From the Family.

Parkes, Samuel. A chemical catechism for the use of young people: with copious notes for the assistance of the teacher, to which are added a vocabulary of chemical terms, useful tables, and a chapter of amusing experiments. ill. London 1806. From the Lawes Trust.

Violette, J. H. M., and Archambault, P. J. Dictionnaire des analyses chimiques, ou répertoire alphabétique des analyses de tous les corps naturels et artificiels depuis l'origine de la chimie jusqu'a

nos jours, avec l'indication du nom des auteurs et des recueils où elles ont été insérées. 2 vols. Paris 1851. From the Lawes Trust.

Weltzien, Karl, and Lang, H. Das chemische Laboratorium an der grossherzogl. polytechnischen Schule zu Carlsruhe. ill. Carlsruhe 1853. From the Lawes Trust.

II. By Purchase.

Schnabel, Carl. Lehrbuch der allgemeinen Hüttenkunde. 2nd ed. ill. Berlin 1903.

Hoppe-Seyler, Ernst Felix Immanuel. Handbuch der physiologisch- und pathologisch-chemischen Analyse für Aerzte und Studirende. Edited by H. Thierfelder. 7th ed. ill. Berlin 1903.

Liebrich, Oscar. Ueber die Wirkung der Borsäure und des Borax. (Ein zweites Gutachten.) ill. Berlin 1903.

Lüpke, Robert. Grundzüge der Elektrochemie auf experimenteller Basis. 4th ed. ill. Berlin 1903.

III. Pamphlets.

Borns, Henry. Die Elektrochemie im Jahre 1896 (1897—1901).

Citron or Cedrat Oil (Citrus Medica). A review of recent research work on the constants of this oil. 1903.

Harrison, John Burchmere. Report on the agricultural work in the Botanic Gardens and the Government Laboratory for the years 1896—1901. British Guiana, Georgetown, Demerara 1902.

Van Slyke, L. L., and Hart, E. B. Some of the compounds present in American Cheddar Cheese (*being Bull. No.* 219, *New York Agric. Exper. Station*). 1902.

Collins, Sidney Hoare. Composition of Milk in the North of England. London 1903.

Collins, Sidney Hoare. Sugar in Swedes. Part II. London 1903.

Stocks, Herbert Birtwhistle, and H. Graham White. Sizing and sizing materials. London 1903.

Patten, Harrison Eastman. Influence of the solvent in electrolytic conduction. 1902.

Freer, Paul C. The preparation of benzoylacetylperoxide, and its use as an intestinal antiseptic in cholera and dysentery. Manila 1902.

Taylor, Robert Llewellyn. On the reaction of iodine with mercuric oxide in presence of water. Manchester 1902.

Smith, Alexander, and Holmes, Willis B. On amorphous sulphur. (Univ. of Chicago Decennial Publications.) Chicago 1902.

Cutolo, Alessandro. Contributo all' analisi degli olii. (*From the Bull. Soc. Nat. Napoli*, 15, 1901.)

ANNIVERSARY DINNER.

It has been arranged that the Fellows of the Society and their friends shall dine together at the Whitehall Rooms, Hotel Métropole, at 6.30 for 7 o'clock, on **Wednesday, March 25th, 1903** (the day fixed for the Annual General Meeting).

The price of the tickets will be **One Guinea each, including wine.**

The Secretaries will be glad to have, **at as early a date as possible,** the names of Fellows and their guests who propose to dine. All applications for tickets must be received **not later than Wednesday, March 18th.**

Tickets will be forwarded to Fellows **on receipt of a remittance** for the number required, addressed to the **Assistant Secretary,** Chemical Society, Burlington House, W.

ANNUAL GENERAL MEETING.

The Annual General Meeting of the Society for the Election of Officers and other business will be held on **Wednesday, March 25th, at half past four** o'clock in the afternoon.

At the next meeting, on **Wednesday, March 18th, 1903, at 5.30 p.m.,** the following papers will be communicated:

"Essential oil of hops." By A. C. Chapman.

"A compound of dextrose with hydroxide of aluminium." By A. C. Chapman.

"Action of phosphorus haloids on dihydroresorcins. Part II. Dihydroresorcin." By A. W. Crossley and P. Haas.

"The constitution of cotarnine." By J. J. Dobbie, A. Lauder, and C. K. Tinkler.

"The decomposition of mercurous nitrite by heat." By P. C. Ray and J. N. Sen.

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Issued 31/3/03

PROCEEDINGS

OF THE

CHEMICAL SOCIETY.

Vol. 19. No. 263.

Wednesday, March 18th, 1903. Professor J. Emerson Reynolds, Sc.D., F.R.S., President in the Chair.

Messrs. J. M. Wadmore, J. Phelps, and F. Soddy were formally admitted Fellows of the Society.

Certificates were read for the first time in favour of Messrs.

William Lester St. John Alton, Dungarvan, Putney Heath, S.W.
Henry Gough, c/o. Messrs. J. Lovibond & Sons, Ltd., Greenwich, S.E.
William Kirkby, Winster House, Thornfield Road, Heaton Moor.
John George Collcutt Lock, 17 Berners Street, W.
George G. Pond, M.A., Ph.D., State College, Pennsylvania, U.S.A.
Robert James Porter, 11, Arlington Street, Hull.
Ernest William Sawdon, B.Sc., 2, Esk Terrace, Whitby.
Giles Hadden Welsford, 6, The Orchard, Blackheath, S.E.

The PRESIDENT stated, in reference to a petition which had been recently presented to the Council, that he had the authority of the Council to communicate to the Society the terms of the petition

and of the resolution of the Council with regard to it. The terms of the petition were:

"We, the undersigned Fellows of the Chemical Society, being of opinion that the interests of the general body will be promoted by limiting the period of service of the Honorary Secretaries and Foreign Secretary, do hereby request the Council to earnestly consider the desirability of so limiting the tenure of office."

The resolution passed by the Council *nem. con.*, which was duly communicated to Mr. C. E. Groves, who represented the petitioners, was "That this Council is of opinion that the tenure of office of the Officers of the Society should not be indefinitely extended, but that it is not desirable to limit the period by assigning a definite term of years to the tenure of each office."

Of the following papers those marked * were read:—

*45. "Essential oil of hops." By A. C. Chapman.

Since the publication of the earlier results of the study of oil of hops (*Proc.*, 1893, 177; *Trans.*, 1895, 67, 54, and 780), three more samples of oil of undoubted genuineness have been examined. These had the following specific gravities and specific rotations:

	Sp. gr. 15°/15°.	Sp. gr. 20°/20°.	$[\alpha]_D^{20°}$.
No. 5.....	0·8676	0·8645	+0·30°
No. 6.....	0·8639	0·8610	−0·20°
No. 7.....	0·8403	0·8357	−0·08°

The fraction of lowest boiling point, obtained after prolonged fractional distillation under reduced pressure, consisted of a hydrocarbon $C_{10}H_{16}$, which had the following properties: sp. gr. 0·8046 at 15°/15° and 0·8020 at 20°/20°; b. p. 74—75° (33 mm.) and 166—168° (774 mm.), undergoing at the same time slight polymerisation. It was optically inactive and had a refractive index 1·4645 at 20° and a molecular refraction 46·8, the calculated number for $C_{10}H_{16}$ (with 3 double linkings) being 46·78. This compound is therefore an aliphatic hydrocarbon, and its properties are almost identical with those of myrcene; it absorbs oxygen from the atmosphere and readily undergoes polymeric change, becoming converted into a colourless resin.

The next fraction (b. p. 120—130°, 46 mm.) was a very small one, and gave on analysis numbers agreeing with the formula $C_{10}H_{18}O$. It had a sp. gr. 0·8571 at 20°/20°, produced a rotation of ¦ −0°40′ in a

100 mm. tube, and evidently consisted of inactive linalool mixed with a small quantity of some active substance.

The third small fraction (b. p. 135—150°, 46 mm.) consisted of an ester, and yielded on saponification *iso*nononoic acid, $C_9H_{18}O_2$, and linalool, together with a small quantity of geraniol.

The highest and largest fractions in all three samples of oil consisted of nearly pure humulene. On submitting the oil to the action of boiling chromic acid mixture, it yielded acetic, valeric, succinic, unsymmetrical dimethylsuccinic (m. p. 140°), and *iso*nononoic acids, the last of these having been probably derived from the linalyl ester. When dilute nitric acid was employed in the oxidation, oxalic and acetic acids were the chief soluble products of acidic character.

Oxidation experiments made with the fractionated constituents of the oil showed that the dimethylsuccinic acid is derived from the humulene, and succinic acid from the myrcene.

The essential oil of hops therefore contains the following compounds myrcene, humulene, linalool, linalyl *iso*nononoate, with small quantities of a diterpene and probable traces of some ester of geraniol.

In all the freshly distilled samples of oil examined, the hydrocarbons myrcene and humulene were present to the extent of from 80 to 90 per cent.

Discussion.

Dr. Power remarked that the results obtained by Mr. Chapman seemed to leave no doubt respecting the identity of the hydrocarbon of low boiling point contained in hop oil with the myrcene of oil of bay. Attention was also called to the fact that, apart from the interest connected with the general properties of myrcene and the occurrence of such an olefinic terpene in nature, it has recently been utilised in a study of the chemical composition of Para rubber. Harries (*Ber.*, 1902, **35**, 3259) has shown that when rubber is treated with nitrous acid it yields a series of nitrosites, one of which has the molecular composition $(C_{10}H_{15}O_7N_3)_2$, and appears to be identical in every respect with a nitrosite obtained from a product of the polymerisation of myrcene termed dimyrcene, $C_{20}H_{32}$. It is thus rendered probable that myrcene stands in very close relationship to isoprene and caoutchouc.

In reply to Professor Tilden, Mr. Chapman said that he had not obtained any evidence of the existence of pinene in the oil. The slight optical activity was, in all probability, due to the presence of a small quantity of active linalool, but the intermediate fractions were so small, even when working with considerable quantities of the oil, that it was impossible to arrive at a definite conclusion in regard to this point.

$C_{20}H_{30}N_6O_{14} + 4H_2O$

***46. "A compound of dextrose with aluminium hydroxide." By A. C. Chapman.**

The author has obtained a compound of dextrose with aluminium hydroxide by the following process.

To a solution of 8 grams of pure anhydrous aluminium chloride in about 1500 c.c. of 90 per cent. alcohol, powdered dextrose was added until it no longer dissolved after allowing the mixture to remain some time in a warm place. The white, gelatinous precipitate immediately produced by adding aqueous ammonia in slight excess to the filtered solution was collected, washed with 90 per cent. alcohol, and dried until of constant weight in an exhausted desiccator over sulphuric acid. It was not found possible by repeated washing to remove the last trace of chlorine, a small quantity invariably remaining, apparently in the form of a basic chloride. By careful treatment it is, however, possible to obtain a preparation which, after drying, will not contain more than 0·2 to 0·5 per cent. of chlorine.

Many different preparations of this compound were made with slightly varying proportions of dextrose and aluminium chloride. The analytical results, although fairly concordant, do not correspond with any simple formula:

(1) 0·6010 gave 0·376 CO_2 and 0·276 H_2O. C = 17·06; H = 5·10.
(2) 0·4270 „ 0·275 CO_2 „ 0·196 H_2O. C = 17·56; H = 5·08.
(3) 0·4135 „ 0·264 CO_2 „ 0·185 H_2O. C = 17·41; H = 4·96.
(4) 0·6010 „ 0·250 Al_2O_3; Al = 22·01.

Three other estimations gave Al = 22·12, 22·18, and 22·34.

$[3C_6H_{12}O_6,5Al_2O_3,11H_2O]$ requires C = 17·39; H = 4·67; Al = 21·80 per cent.

From these results, it appears probable that the white, flocculent precipitate is a compound of 3 mols. of dextrose with 5 mols. of aluminium hydroxide $[3C_6H_{12}O_6,5Al_2(OH)_6]$, and that this compound, when dried in an exhausted desiccator over sulphuric acid, loses approximately 4 molecules of water (compare *Trans.*, 1889, **55**, 576; 1891, **59**, 224).

This aluminium compound is a white, amorphous substance, insoluble in water and alcohol, but dissolving in dilute acids. It differs from the similar compounds of dextrose with the oxides of iron and chromium in being insoluble in water when freshly precipitated; with boiling water, it undergoes partial decomposition into aluminium oxide and dextrose. On drying for some hours at 100°, the substance lost 12 per cent. of its weight and acquired a pale yellow colour, but did not char appreciably at this temperature; it burned with extreme

readiness when heated more strongly, yielding a mixture of the metallic oxide mixed with carbon, the final residue after prolonged ignition consisting of aluminium oxide.

*47. "Action of phosphorus haloids on dihydroresorcins. Part II. Dihydroresorcin." By A. W. Crossley and P. Haas.

Dihydroresorcin behaves towards phosphorus haloids in a similar way to its dimethyl derivative (*Trans.*, 1903, 83, 110), in fact, as if it possessed the following formula : $CH_2<\begin{matrix}CH_2\text{——}CO\\CH_2\cdot C(OH)\end{matrix}>CH$.

5-Chloro-3-keto-Δ^4*-tetrahydrobenzene*, $CH_2<\begin{matrix}CH_2\text{—}CO\\CH_2\cdot CCl\end{matrix}>CH$, obtained by the action of phosphorus trichloride on dihydroresorcin, is a colourless, highly refractive liquid boiling at 104° (24 mm.); it gives a *semicarbazide* melting at 190° and on oxidation is converted into glutaric acid.

The corresponding *bromo*-derivative boils at 132·5—133° (52 mm.).

Phosphorus pentachloride gave rise to 3 : 5-*dichloro-*$\Delta^{2:4}$*-dihydrobenzene*, $CH_2<\begin{matrix}CH=CCl\\CH_2\cdot CCl\end{matrix}>CH$, a colourless, refractive liquid boiling at 88—90° (29 mm). On treatment with excess of phosphorus pentachloride or with bromine, it was converted into *m*-dichlorobenzene, and on reduction with sodium in moist ethereal solution, yielded a mixture of di- and tetra-hydrobenzenes. This mixture of hydrocarbons readily absorbed two atoms of bromine, and the resulting liquid deposited crystals of *dibromodihydrobenzene*, $C_6H_8Br_2$, which separated from light petroleum in transparent, hexagonal prisms melting at 104·5°, and decomposing at 170° with evolution of hydrogen bromide.

*48. "The constitution of cotarnine." By J. J. Dobbie, A. Lauder, and C. K. Tinkler.

Although previous investigators are in agreement as to the possible existence of the carbinol form of cotarnine, the question as to whether this constitution or one expressed by an open chain formula should be assigned to solid cotarnine has hitherto remained unsettled. A satisfactory answer has now been furnished by the study of the absorption spectra of this substance and its derivatives. Solid cotarnine begins to undergo a constitutional change as soon as it comes into contact with water or alcohol, but is not altered either by ether or chloroform, and the spectra of the ethereal and chloroform solutions, which may therefore be regarded as the true spectra of cotarnine,

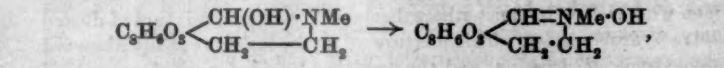
agree perfectly with one another and also with those of hydrocotarnine and its salts; moreover, they are identical with those of the cyanide and ethoxyhydrocotarnine, these substances having been regarded as derivatives of the carbinol form.

The spectra of dilute aqueous or alcoholic solutions of cotarnine and those given by a solution of cotarnine hydrochloride from which the chlorine has been removed by means of silver oxide are almost identical with the spectra of cotarnine hydrochloride, which, on the other hand, differ widely from the spectra of cotarnine in ether.

Cotarnine and all its derivatives hitherto examined spectroscopically conform to one or other of these two forms of spectra. (i) The spectra of cotarnine in aqueous or alcoholic solution and of cotarnine salts show a large amount of general absorption with two well-marked absorption bands, one of which is close to the visible region. (ii) The spectra of cotarnine in ether or chloroform, hydrocotarnine, ethoxycotarnine, and cotarnine cyanide show less general absorption than the former, and have a band much further removed from the visible region.

The substances in the first class are yellow, those in the second are colourless; the latter can all be represented as having a carbinol constitution.

When cotarnine is dissolved in anhydrous alcohol, it changes from the carbinol to the quaternary ammonium hydroxide form,



the rearrangement being promoted either by increasing the mass of the alcohol present or by heating. The transformation is effected much more rapidly by methyl than by ethyl alcohol.

A colourless solution of cotarnine in alcohol cannot be obtained, but, since this isomeric change proceeds slowly, it is possible in ethyl alcohol, by photographing the freshly prepared solution immediately, and again after successive intervals of time, to trace the transformation through all its phases. The rate of progress of the change may even be determined by comparing photographs of the alcoholic solution with those of the spectra of mixtures of the solutions of the hydrochloride (ammonium form) and the cyanide (carbinol form) in known proportions. Potassium, sodium, and barium hydroxides, and even ammonia, promote the reverse change to that effected by alcohol. When cotarnine hydrochloride in solution is decomposed by sodium hydroxide, the cotarnine changes at once to the carbinol form, but if an aqueous solution of cotarnine is treated with successively larger quantities of this alkali, the reverse change is gradual, and, as in the case of the opposite change induced by alcohol can be distinctly

traced through its various phases. These results explain several of the peculiarities observed by Hantzsch and Kalb (*Ber.*, 1899, 32, 3109) in their experiments on the conductivity of cotarnine.

Preliminary experiments indicated that similar results are given by hydrastinine.

Discussion.

Mr. Baly said that an interesting comparison could be drawn between these absorption spectra of cotarnine compounds and those obtained by Hartley and Dobbie with derivatives of *o*-oxycarbanil. In the latter case, the lactam esters correspond to the derivatives from the ammonium hydroxide form of cotarnine and the lactim esters to the derivatives from the carbinol form. The absorption spectra of the lactim esters of *o*-oxycarbanil and of the ammonium hydroxide form of cotarnine both have more general absorption with the absorption band nearer to the visible region than in the case of the spectra of the lactim esters of *o*-oxycarbanil and the carbinol form of cotarnine. This contrast appears to be the opposite of that observed in the keto- and enolic forms of carbon compounds.

Dr. Orton asked whether the addition of a small quantity of alcohol to the ethereal solution of cotarnine, in which the alkaloid was present in the carbinol (or pseudo-ammonium) form, effected a *complete* conversion of the carbinol into the true ammonium base; or was, on the other hand, a point of equilibrium reached which was only displaced by addition of a further quantity of alcohol? As the presence of small quantities of bases such as piperidine has such a marked influence on similar isomeric changes, preventing the change of a non-basic into a basic substance and facilitating the reverse process, it would be of interest to know whether any similar observations on the transformation of cotarnine under the influence of alcohol had been made.

In reply to Mr. Baly, Professor Dobbie stated that no such general relation between the absorption spectra of lactams and lactims, as seemed to be implied in the question, had been established.

With reference to Dr. Orton's question, he stated that the amount of change produced by sodium hydroxide in an aqueous solution of cotarnine was found to be proportional to the quantity of caustic alkali added, when the solution was examined immediately after the addition of this reagent. The effect of time on the alkaline solution had not yet been fully investigated.

*49. "Decomposition of mercurous nitrite by heat." By P. C. Rây and J. N. Sen.

When mercurous nitrite was decomposed by heat in a tube connected with a Sprengel pump, nitric oxide escaped mixed with very little nitrogen peroxide, crystals of mercurous nitrate were projected across the upper and cooler part of the tube, just over the decomposing salt, a very little metallic mercury and its basic nitrate were deposited at the sides, whilst a small quantity of amorphous, orange-coloured mercuric oxide was left in the place of the decomposed nitrite. Except when the greater portion of the nitrate which had formed at first had been decomposed by heating more strongly, the average amount of nitric oxide produced corresponded with only 3·3 out of the 5·7 per cent. of nitrogen contained in the nitrite.

The production of mercurous nitrate was evidently due to interaction between nitrogen peroxide and mercury vapour, nitric oxide being the other product. In decomposing, the mercurous nitrite behaves partly as if it had a non-oxylic constitution in yielding mercury and nitrogen peroxide, and partly as if it had an oxylic constitution in giving rise to mercuric oxide and nitric oxide.

Discussion.

Dr. Divers said that the authors' observation of the conversion into crystals of mercurous nitrate of the nitric peroxide and mercury vapour coming from the mercurous nitrite was very interesting and recalled the production of crystals of mercurous chloride from a mixture of mercury vapour, air, and hydrochloric acid, which occurred in the manufacture of that substance in the old Japanese way. It also strikingly confirmed, as the authors had pointed out, the accuracy of the account of the decomposition of silver nitrite, given by Shimidzu and himself years ago. He considered the authors to be mistaken as to the origin of the small quantity of mercuric oxide, which was always produced. That this formed just where the mercurous nitrite had lain was not that the nitrite had directly decomposed into mercuric and nitric oxides, but that, by the use of a small flame as applied, this spot was the only part of the tube sufficiently hot to bring about the well-known decomposition into this oxide of the mercurous nitrate which was forming out of the gas and vapour, equally and as much here as in the upper and cooler part of the tube.

50. "The action of nitrogen tetroxide on pyridine." By J. F. Spencer.

In attempting to nitrate pyridine, the author studied the action of nitrogen tetroxide on this base, and although nitropyridine was not isolated an isomeride was produced. The nitrogen tetroxide, which was prepared by the direct combination of nitric oxide and oxygen, was employed either in the gaseous form or as a liquid at low temperatures; but these variations of the experimental conditions did not materially affect the course of the reaction, which gave rise to the same product whether the base was treated alone or in the presence of various solvents.

The first product is an unstable, white, crystalline compound which was shown by analysis to be an additive compound of pyridine and nitrogen tetroxide. The further action of the latter reagent led to the production of a solid, black substance, which, when treated with water, entirely dissolved, yielding a brownish-red solution; this solution, on further dilution, gave a yellow, amorphous deposit (i) amounting to about $\frac{1}{4}$ per cent. of the pyridine taken. The filtrates, when rendered alkaline, furnished 70 per cent. of unaltered pyridine, but no other basic substance. If, however, the alkaline solution was acidified, it gave a purplish-brown precipitate (ii), the composition of which was not determined.

(i) The yellow product, which is insoluble in all the ordinary organic solvents except pyridine, dissolves in mineral acids or aqueous alkalis forming deep red solutions; when rapidly heated, it decomposes explosively at 234°; on distillation with zinc dust, it yields pyridine:

0·1986 gave 0·3530 CO_2 and 0·0568 H_2O. C = 48·66; H = 3·19.
0·0691 „ 13·44 c.c. moist nitrogen at 13° and 764·6 mm. N = 22·77.
$C_5H_4O_2N_2$ requires C = 48·38; H = 3·22; N = 22·58 per cent.

These results were confirmed by many additional analyses. The hydrochloric acid solution of this substance yielded a platinichloride containing 13·53 per cent. Pt. Calculating the molecular weight of the polymeride from this result, the value 521 is obtained; this corresponds with the molecular formula $(C_5H_4O_2N_2)_4$, which has a molecular weight 496. All attempts to depolymerise this substance failed; mild reducing agents had no action, although tin and hydrochloric acid reduced it to a basic compound, the platinichloride of which contained 31·49 per cent. Pt, whilst $(C_5NH_4{\cdot}NH_2)_2H_2PtCl_6$ requires 32·6 per cent. Pt.

(ii) The purple substance somewhat resembles the yellow compound, but is evidently more complex.

The unsatisfactory yields and the highly complex nature of the products have rendered it impossible to pursue this investigation.

ADDITIONS TO THE LIBRARY.

I. Donations.

Reynolds, Osborne. The sub-mechanics of the universe. Published for the Royal Society of London. Cambridge 1903.
From the Author.

Weinberg, Boris. L'enseignement pratique de la physique dans 206 laboratoires de l'Europe, de l'Amerique, et de l'Australie. Odessa 1902. From the Author.

Henri, Victor. Lois générales de l'action des diastases. Paris 1903. From the Author.

Plimmer, Robert Henry Aders. The chemical changes and products resulting from fermentations. London 1903.
From the Publishers.

Nilson, Lars Fredrik, and Jolin, Severin. Minnesfesten öfver Berzelius den 7 Oktober 1898. Beskrifning på uppdrag af kungl. vetenskaps akademien. Stockholm [1901]. From the Academy.

Clowes, Frank, and Coleman, Joseph Bernard. Quantitative chemical analysis, adapted for use in the laboratories of colleges and schools. 6th ed. ill. London 1903. From the Publishers.

At the next ordinary meeting, on **Thursday**, April 2nd, 1903, at 8 p.m., the following papers will be communicated:

"On the absorption spectra of nitric acid in various states of concentration." By W. N. Hartley.

"The dioximes of camphorquinone and other derivatives of *iso*nitrosocamphor." By M. O. Forster.

"Salts of a mercaptoid isomeric form of thioallophanic acid, and a new synthesis of iminocarbaminethioalkyls." By A. E. Dixon.

"Discoloured rain." By E. G. Clayton.

"Derivatives of *o*-aminobenzophenone and *p*-aminobenzophenone." By F. D. Chattaway.

"Reversibility of enzyme or ferment action." By A. C. Hill.

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Issued 9/4/03

PROCEEDINGS

OF THE

CHEMICAL SOCIETY.

Vol. 19. No. 264.

March 25th, 1903. Annual General Meeting. Professor J. EMERSON REYNOLDS, Sc.D., F.R.S., President, in the Chair.

Dr. L. T. Thorne and Dr. K. J. P. Orton were appointed Scrutators, and the ballot was opened for the election of Officers and Council for the ensuing year. The President then presented the following Report on the state of the Society during the past twelve months:

REPORT OF THE COUNCIL.

The Council have the satisfaction of announcing that the numerical strength of the Society which, on March 26th, 1902, was 2416, is now 2471, the highest number yet reached. Since the last Annual General Meeting, 130 Fellows have been elected and 6 have been reinstated by the Council, making a gross total of 2552. Of these, 27 have been removed for non-payment of two subscriptions, 33 have withdrawn,

and 21 have died, making 55 the net increase in the number of Fellows.

By the death of Professor J. Wislicenus, F.R.S., the number of Foreign Fellows has been reduced to 31.

The following Fellows have withdrawn:

A. Abbott.	R. H. C. Gompertz.	J. Robinson.
C. Armitage.	H. W. Gough.	W. Russell.
W. P. Ashe.	J. P. Jenkins.	S. P. Sadtler.
C. R. Blackett.	T. Judge.	J. Spilsbury.
H. V. Buttfield.	J. Lunt.	T. C. Squance.
A. W. Clayden.	W. B. Mason.	R. W. Steel.
A. H. Downes.	C. K. Millard.	D. R. Steuart.
J. Dunn.	J. L. Notter.	W. Taylor.
L. Ehrmann.	T. H. Page.	A. Thomson.
G. Evans.	W. Pullinger.	Rev. W. Watson.
E. I. G. Gill.	J. C. Quinn.	C. W. T. Woods.

The following Fellows have died:

Sir F. A. Abel, Bart., F.R.S.	Dr. J. H. Gladstone, F.R.S.	Sir W. C. Roberts-Austen, K.C.B., F.R.S.
Dr. C. M. Aikman.	G. Griffith.	
F. B. Benger.	Prof. J. J. Hummel.	Dr. E. Schunck, F.R.S.
C. R. Blackett.	R. Jackson.	J. Sim.
Prof. G. Bischof.	W. I. Macadam.	W. H. Stanger.
Dr. E. Demarçay.	J. Moss.	E. Truman.
W. C. Forsyth.	J. Robbins.	M. Zingler.
T. E. Gee.		

The scientific work of the Society during the past session abundantly testifies to its continued activity. Since the last Annual General Meeting, 189 scientific communications have been made to the Society, 118 of which have already been published in the *Transactions*, and abstracts of all have appeared in the *Proceedings*.

The *Transactions* for 1902 contains 160 memoirs occupying 1604 pages, whilst the volume for the preceding year contains 146 memoirs which occupy 1411 pages. In addition, the volume for 1902 contains the Raoult Memorial Lecture.

The *Journal* for 1902 contains also 3854 abstracts of papers published mainly in foreign journals, which extend to 1564 pages. These abstracts may be classified as follows:—

Part I.

	Pages.	No. of Abstracts.
Organic Chemistry	852	1632

Part II.

General and Physical Chemistry		409
Inorganic Chemistry		428
Mineralogical Chemistry		154
Physiological Chemistry		421
Chemistry of Vegetable Physiology and Agriculture		281
Analytical Chemistry		529
	712	2222
Total in Parts I and II	1564	3854

The Council desires to offer the congratulations of the Society to Professor G. D. Liveing, F.R.S., and to Mr. J. G. Hepburn, who this year reach the Fiftieth Anniversary of their election as Fellows.

The Society has to lament the death of one distinguished Foreign Fellow, Professor J. Wislicenus, F.R.S., and of twenty-one Fellows, amongst whom are two Past Presidents, Sir F. Abel, Bart., F.R.S., and Dr. J. H. Gladstone, F.R.S., who had been Fellows for the long period of fifty-five years; other notable names are those of Sir W. C. Roberts-Austen, K.C.B., F.R.S., Professor J. J. Hummel, and Dr. E. Schunck, F.R.S. Obituary notices of these will appear in the Journal.

The Raoult Memorial Lecture was delivered before a large audience in the Theatre of the Royal Institution (the use of which was kindly granted for the occasion by the Managers) on March 26th, 1902, by Professor J. H. van't Hoff, F.R.S.

The Council are glad to be able to announce that Professor W. H. Perkin, F.R.S., has undertaken to deliver the Wislicenus Memorial Lecture towards the end of the present year.

The Society, in conjunction with the Royal Society and the other Scientific Societies having rooms in Burlington House, arranged for the decoration and illumination of the Building on the occasion of the Coronation of the King.

The plan of holding the Ordinary Meetings of the Society alternately on Wednesdays, at 5.30 p.m., and on Thursdays, at 8 p.m., which was tried for the first time last session, proved so satisfactory that the Council determined to continue the practice during the present

session. Both sets of meetings have been equally well attended, and the meetings held on Wednesdays appear, in particular, to suit the convenience of Fellows resident at a distance from London.

The Joint International Committee on Atomic Weights, on which the Society is represented by Professor Thorpe, has issued its first Report. This report, which includes a new table of atomic weights, has been printed in full, both in the *Journal* and the *Proceedings*.

The Society having been invited by the Organising Committee of the Fifth International Congress of Applied Chemistry to co-operate with other societies in this country in securing a proper representation of English chemistry, the Council, in June last, appointed a committee to take action in the matter, and have nominated, as its Delegates to represent the Society at the meeting of the Congress in Berlin in June next, the following Fellows: Professor W. A. Tilden, Professor W. R. Dunstan, Professor W. H. Perkin, and Dr. A. Scott.

A petition has been addressed to the Council requesting them to consider the desirability of limiting the period of service of the Honorary Secretaries and of the Foreign Secretary. The Council having fully considered the matter, passed, *nem. con.*, a resolution stating that whilst the tenure of office should not be indefinitely extended, it was not expedient to fix a definite term of years to the tenure of these offices.

The rapid growth of the Library rendered it imperative that additional accommodation for its extension should be obtained at once. This has been accomplished by utilising for that purpose some of the rooms of the basement, and plans are at present under consideration by which storage accommodation there for the less used books may allow of the normal growth of the Library for another ten or twelve years without its being unduly cramped. This, along with the constantly increasing amount of work entailed by the continuous growth and prosperity of the Society, rendered necessary the rearrangement of the duties of the Staff. After careful consideration, the Council decided to separate the duties of Assistant Secretary from those of the Librarian and Curator, Mr. Steele retaining the latter, whilst Mr. S. E. Carr has been appointed Assistant Secretary.

A complete card catalogue of the Library has now been made, and the new Catalogue, arranged both according to authors and subjects, was issued at the beginning of the present year at the price of half-a-crown. The Library continues to be increasingly used by the Fellows. 925 books were borrowed during the year as against 873 in the previous year. The additions to the Library comprised 64 books, 338 volumes of periodicals, and 23 pamphlets, the corresponding numbers of which in the year before were 153, 441, and 33 respectively. Of the books, 48 have been presented to the Society.

Grants amounting in all to £230 have been made from the Research Fund.

The Council here desires to place on record its high appreciation of the conspicuous services of Professor Dunstan, who now retires from the post of Honorary Secretary which he has held with such advantage to the Society, and who, for the last ten years, has given unsparingly both his time and his energy to the promotion of its highest interests. As one of the Vice-Presidents, the Council hope to have him among them for some time to come.

Another material change in the administrative officers of the Society comes into force with the nomination of the Treasurer, Professor Tilden, to the highest office in the Society, that of President. The Council acknowledges with gratitude the skill and foresight with which, for the last four years, he has controlled the finances of the Society, and it is largely owing to his management, as well as to the ever increasing prosperity of the Society, that the Council has been able to introduce several important reforms and rearrangements. These are alluded to elsewhere in this report, and it is hoped that they will greatly increase the usefulness of the Society.

Professor W. P. Wynne found it necessary, to the great regret of the Council, to resign the post of Editor of the *Journal* which he has held for the last four years with such credit to the Society, but kindly consented to act as Editor until the end of 1902, when he was succeeded by Dr. G. T. Morgan, who, in addition to editing the *Journal*, now edits the *Proceedings* of the Society.

REPORT OF THE TREASURER.

The Treasurer, in presenting the balance sheet for the year, stated that the net income was £6212 5*s.* 1*d.*, whilst the expenses had been £5384 18*s.*, leaving a surplus of £827 7*s.* 1*d.*, which was about one hundred pounds less than the surplus income in 1902. This was due to several causes, namely, the increase of nearly £380 in the cost of the *Journal* and *Proceedings*, the additions to the item of salaries and wages, and the expenses on account of the Collective Index. Whilst, therefore, the present surplus is satisfactory in that it exceeds the amount paid into the account in the form of compositions and admission fees, all these three forms of expenditure will still require careful watching. Three years ago, at the end of his first year as Treasurer, he made an appeal to authors of papers with reference to the preparation of copy for the printers, and he could not help thinking that in the near future more stringent regulations in regard both to the state of the manuscript and the dimensions of papers would have to be imposed with the object of keeping the cost of printing within the means at

the disposal of the Society. The Abstracts of foreign and other journals are now indispensable, but, notwithstanding the care exercised by the Sub-Editor, to whom the Society is greatly indebted, and the very moderate remuneration of the excellent body of Abstractors, the cost of their preparation is very heavy.

The amount which will appear in the next balance sheet under the heads of salaries and wages will be somewhat larger, inasmuch as the increase will represent that for an entire year instead of only half a year as on the present occasion. The total cost of the last two volumes of the General Index was £1740, whilst the expenditure on the volume which is in course of preparation has, up to the present, been £204. The greater part of the cost is therefore still to be met. On the other hand, the Library Catalogue is now completed, and for some years there need be no further expense in that form, although additional accommodation for the books will have to be provided immediately at an outlay which will probably approach £200.

The following tabular statement contains the chief items of income and expenditure during the past four years. The figures represent pounds, the shillings and pence being omitted. It will be seen that whilst the income of the Society is increasing the expenses are growing at nearly the same rate.

	1900.	1901.	1902.	1903.
Compositions	110	282	168	299
Admission Fees	468	464	652	520
Subscriptions	3510	3544	3712	3957
Sale of Journals	781	880	835	888
Dividends	444	464	476	506
Net Income	5371	5668	5844	6212
Assets	16710	17156	17807	18446
Expenses	4993	4932	4913	5384
Surplus	377	736	930	827

The Treasurer recalled with satisfaction the sale of Consols previously held by the Society in his first year of office. A serious loss was thus avoided, and, by the reinvestment of the proceeds, a slight addition was secured to the income of the Society.

The estimated values of the securities are all slightly less than at this time last year, but the further investment in May last in £1200 of Leeds Corporation Stock now brings the Assets of the Society to the respectable figure of £18,446 17*s.* 3*d.*

The TREASURER, in concluding, proposed a vote of thanks to the Auditors, which was acknowledged by Dr. L. T. THORNE.

Professor DEWAR proposed a vote of thanks to the Treasurer, Secretaries, and Council. The motion was seconded by Professor W. H. PERKIN, and unanimously adopted. Professor DUNSTAN responded.

The PRESIDENT then delivered his address, in which he called attention to the publication of some recent reports on progress in chemical research, and urged the publication of similar digests. He mentioned that this year would see the centenary of Dalton's statement of his atomic theory, which rose, as Nernst truly said, "by a single effort of modern science, like a phœnix from the ashes of the old Greek philosophy." He urged the study of "comparative chemistry" of inorganic compounds. There were few inquiries of greater interest than those involving inorganic isomerism, which was now either completely ignored or only slightly mentioned. Polymerism, or molecular condensation, was well known to exist in many inorganic compounds, as in the oxides of nitrogen, vanadium, niobium, and tantalum. Silicon showed a great analogy to carbon, and it was highly probable that some of the native silicates were benzenoid combinations of $6SiO_2$. The more familiar cases of isomerism were the nitrites and sulphites, and isomerism had also been observed in the thiosulphates and the salts of the phosphorous acids. Attention was directed to some cobalt, platinum, and molybdenum compounds which showed this peculiarity. Another analogy between carbon and inorganic compounds was the curious and interesting catalytic action, referred to by Bredig under the title of "inorganic ferments." Colloid platinum solutions acted on many substances in the same way and under similar laws as enzymes. The whole subject was little known, but it suggested that the broader study of inorganic chemistry, especially in the light of our knowledge of the "organic" division of the science, was well worthy of much greater attention than it had received of late.

Dr. RUSSELL, in moving the adoption of the report, proposed a vote of thanks to the President, coupled with a request that he would allow his address to be printed in the *Transactions*.

Professor THORPE seconded the motion, which was carried by acclamation.

After the President had returned thanks, the Scrutators presented their report to the President, when he declared the following to have been duly elected as Officers and Council for the ensuing session :—

President: W. A. Tilden, D.Sc., F.R.S.

Vice-Presidents who have filled the office of President: H. E. Armstrong, Ph.D., LL.D., F.R.S.; A. Crum Brown, D.Sc., LL.D., F.R.S.; Sir W. Crookes, F.R.S.; James Dewar, M.A., LL.D., F.R.S.; A. Vernon Harcourt, M.A., D.C.L., F.R.S.; H. Müller, Ph.D., LL.D., F.R.S.; W. Odling, M.A., M.B., F.R.S.; W. H. Perkin, Ph.D., LL.D., F.R.S.; J. Emerson Reynolds, Sc.D., M.D., F.R.S.; Sir H. E. Roscoe, LL.D., F.R.S.; W. J. Russell, Ph.D., F.R.S.; T. E. Thorpe, C.B., LL.D., F.R.S.; A. W. Williamson, LL.D., F.R.S.

Vice-Presidents: Wyndham R. Dunstan, M.A., F.R.S.; P. F. Frankland, LL.D., F.R.S.; David Howard; Herbert McLeod, F.R.S.; Raphael Meldola, F.R.S.; H. A. Miers, D.Sc., F.R.S.

Secretaries: A. Scott, M.A., D.Sc., F.R.S.; W. P. Wynne, D.Sc., F.R.S.

Foreign Secretary: Sir W. Ramsay, K.C.B., LL.D., F.R.S.

Treasurer: Horace T. Brown, LL.D., F.R.S.

Other Members of Council: J. J. Dobbie, M.A., D.Sc.; Augustus E. Dixon, M.D.; M. O. Forster, Ph.D., D.Sc.; A. Harden, D.Sc., Ph.D.; J. T. Hewitt, M.A., D.Sc.; C. A. Kohn, Ph.D., B.Sc.; J. E. Marsh, M.A.; E. J. Mills, D.Sc., LL.D., F.R.S.; S. U. Pickering, M.A., F.R.S.; S. Ruhemann, M.A., Ph.D.; J. A. Voelcker, Ph.D.; James Walker, D.Sc., F.R.S.

ANNIVERSARY DINNER.

The Anniversary Dinner of the Society took place at the Whitehall Rooms on Wednesday, March 25th, at 7 p.m., when the following Fellows and their guests dined together:—

Abney, Sir W., K.C.B., F.R.S.
Adie, Mr. R. H.
Alldred, Mr. C. H.

Baker, Mr. H. B., F.R.S.
Barlet, Mr. S.
Bauerman, Prof. H.
Beadle, Mr. C.
Bennett, Mr. J. H.
Bewsher, Mr. S.
Bowley, Mr. J. J.
Boys, Prof. C. V., F.R.S.
Brabrook, Mr. E. W., C.B.
Brough, Mr. B. H.
Brown, Mr. H.
Brown, Dr. H. T., F.R.S., *Treasurer-Elect.*

Carr, Mr. S. E., *Assistant Secretary.*
Chapman, Mr. A. C.
Chattaway, Dr. F. D.
Chaytor, Mr. A. H.
Clapp, Mr. R. R.
Connah, Mr. J.
Cooper, Mr. A.

Dickins, Mr. F. V., C.B.
Divers, Prof., F.R.S.

Dodds, Mr. J. M.
Dowson, Dr. W.
Dunstan, Prof. W. R., F.R.S., *Hon. Secretary and Vice-President-Elect.*
Dyer, Dr. B.

Eastick, Mr. C. E.
Epps, Mr. J., jun.

Fairley, Mr. T., *President of the Society of Public Analysts.*
Fenton, Mr. H. J. H., F.R.S.
Fletcher, Mr. L., F.R.S.
Forster, Dr. M. O.

Glazebrook, Dr. R. T., F.R.S. *President of the Physical Society.*
Gordon, Mr. J. G.
Goulding, Mr. E.
Gowland, Prof. W.
Greenaway, Mr. A. J., *Sub-Editor.*

Hall, Mr. E. B.
Hall, Mr. S.
Harden, Dr. A.
Hartley, Mr. H.
Hartley, Mr. H. B.
Harvey, Mr. E. W.
Harvey, Dr. J. S.
Henry, Dr. T. A.
Hewitt, Dr. J. T.
Hill, Mr. A. Croft.
Hill, Mr. C. A.
Hills, Mr. W.
Holloway, Mr. G. T.
Howard, Mr. D., *President of the Institute of Chemistry.*
Howie, Mr. W. L.

Jones, Mr. H. O.
Jowett, Dr. H. A. D.
Judd, Prof. J. W., C.B., F.R.S.

Kelvin, Lord, G.C.V.O., O. M., *President of the Royal Society of Edinburgh.*
Kempe, Mr. A. B., F.R.S., *Treasurer of the Royal Society.*
Knowles, Mr. J.

Larmor, Prof. J., *Secretary of the Royal Society.*
Le Rossignol, Mr. A. C.
Le Sueur, Dr. H. R.
Lewkowitsch, Dr. J.
Lock, Mr. C.
Louis, Mr. D. A.
Lowry, Dr. T. M.
Lunge, Prof. G., Ph.D.

McCormick, Rev. Canon, D.D.
MacEwan, Mr. P.
Mackenzie, Capt. N. F.
MacMahon, Major P. A., R.A., F.R.S.
Marr, Mr. J. E., F.R.S.
Marsh, Mr. J. E.
Martin, Mr. N. H.
Martineau, Mr. W.
Matthews, Dr. F. E.
Maxwell, Rt. Hon. Sir H., M.P., F.R.S.
Messel, Dr. R.
Miers, Prof. H. A., F.R.S.
Minssen, Mr. B.
Moody, Dr. G. T.
Morgan, Dr. G. T., *Editor. Morning Post.*
Müller, Dr. H., F.R.S.
Murphy, Mr. A. J.

Newsholme, Mr. G. T. W., *President of the Pharmaceutical Society.*
Nicholson, Mr. F. G.

Orton, Dr. K. J. P.

Page, Mr. F. J. M.
Pam, Mr. A.
Perkin, Mr. A. G.
Perkin, Dr. W. H., F.R.S.
Perkin, Prof. W. H., F.R.S.
Philip, Dr.
Ping, Mr. W.
Pizey, Mr. J. H.
Power, Dr. F. B.
Press Association.
Pritchard, Prof. W.

Ramsay, Sir W., K.C.B., F.R.S., *Foreign Secretary.*
Rawson, Mr. C.
Reynolds, Prof. J. E., F.R.S., *President.*
Richardson, Mr. O. W.
Ruhemann, Dr. S.
Russell, Mr. J. B.
Russell, Mr. T. H.
Russell, Dr. W. J., F.R.S.

Schack-Sommer, Dr. G.
Scott, Dr. A., F.R.S., *Hon. Secretary.*
Smith, Mr. L.
Standard, The.
Steele, Mr. R., *Librarian.*
Stevenson, Dr. T.
Strouts, Mr. E. M.
Sullivan, Dr. Washington.
Swinburne, Mr. J., *President of the Institution of Electrical Engineers.*

Taylor, Mr. R. W. Cooke.
Thiselton-Dyer, Sir W. T., K.C.M.G., F.R.S., *Director of the Royal Gardens, Kew.*
Thomson, Prof. J. M., F.R.S.
Thorpe, Prof. T. E., C.B., F.R.S., *Foreign Secretary of the Royal Society.*
Tidy, Mr. H. L.
Tilden, Prof. W. A., F.R.S., *Treasurer and President-Elect.*

Times, The.
Tyrer, Mr. T.
Voelcker, Dr. J. A.
Wade, Dr. J.
Wallis, Mr. T. E.
Webb, Mr. C. C. J.
Williamson, Mr. S.
Wynne, Prof. W. P., F.R.S., *Hon. Secretary-Elect.*

The following toasts were proposed:—

By The President.

1. His Most Gracious Majesty the King.

2. Her Majesty the Queen Alexandra, their Royal Highnesses the Prince and Princess of Wales, and the other Members of the Royal Family.

By Professor T. E. Thorpe, C.B., F.R.S.,
Foreign Secretary of the Royal Society.

3. The Houses of Legislature, coupled with the names of the Rt. Hon. Lord Kelvin, G.C.V.O., O.M., *President of the Royal Society of Edinburgh*, and the Rt. Hon. Sir Herbert Maxwell, Bart., M.P., F.R.S.

By Sir W. T. Thiselton-Dyer, K.C.M.G., F.R.S.,
Director of the Royal Gardens, Kew.

4. Prosperity to the Chemical Society.

By Professor W. A. Tilden, D.Sc., F.R.S.,
President-Elect of the Chemical Society.

5. The Guests, coupled with the names of Mr. A. B. Kempe, *Treasurer of the Royal Society*, Mr. James Swinburne, *President of the Institution of Electrical Engineers*, and Professor George Lunge, *The Polytechnicum, Zurich.*

The President, in proposing the loyal toasts, said that when the Fellows of the Chemical Society last dined together they were mourning the loss of their great and venerable Queen, and were engaged in a sanguinary war. To-day they were in happier circumstances; the war cloud had disappeared, and that other cloud of suffering through which the King had to pass after his Accession was now but a

memory. They might therefore now rejoice and join with new meaning in the old cry of "Long live the King."

Professor THORPE, in proposing the toast of the Houses of Legislature, said that the theme offered many tempting possibilities. All would admit that both Houses showed an intelligent appreciation of the important part science plays in the conduct of human affairs nowadays, and in directing human development, even to the extent of preserving the national existence of the people for whom these Houses have to legislate.

Now, the House of Lords is singularly fortunate in that it possesses three at least of the most distinguished representatives, not only of British science, but of the science of the whole world—Lord Lister, Lord Rayleigh, and last, but not least, Lord Kelvin, whom we have the honour and pleasure of welcoming here to-night.

It was a circumstance unique in the history of any legislative assembly that there should be at one time three men of such world-wide prominence in the councils of any nation. In France such a thing does not happen; nor even in Germany, so often held up to us as an example of what should be in the relations of the State to science. The House of Commons is not so rich in scientific ornaments. It is true that she possesses in the person of the Secretary of the Royal Society, the Member for the University of London, a man who is a host in himself. As for Sir Herbert Maxwell, like Lord Kelvin, he is no stranger within our gates. His position as a literary man is well known to all. It does not seem to matter to him whether he is chronicling the achievements of some great master in the art of war or of some great master in the art of painting. On history, biography, fiction, natural history, his busy pen has left its mark. He is known in yet another sphere of action to several who are here to-night, and who have had the honour and pleasure of sitting under him on certain departmental committees in which, as a member of the Legislature, he has taken a leading part. Although all may not have seen the results of these inquiries from the same point of view, all are agreed in tendering to Sir Herbert Maxwell their appreciation of his urbanity, courtesy, impartiality, and knowledge of procedure.

In responding for the House of Lords, LORD KELVIN pointed out the blood-relationship which exists between the peerage and modern chemistry, for was not the Hon. Robert Boyle "the father of modern chemistry and brother of the Earl of Cork!" But without straining this relationship too far, there was much in modern science which linked it to the peerage. We have the Marquis of Worcester with his steam-engine, Baron Napier and his logarithms, the Hon. Robert Boyle, Cavendish who added so enormously to our knowledge of

electricity and chemistry, and who obtained argon as a bubble the size of a pin's head by burning the nitrogen of the air with oxygen, Lord Rayleigh, who has made litres and litres of argon, Lord Salisbury, Lord Blythswood, and Lord Lister. But it was not only because the House of Lords contained many scientific men, but because, as Professor Thorpe had remarked, it was a working and a useful part of the Legislature of the British Empire, that he had to thank them for the toast. As for himself, he would like to say that all his life he had tried to be a chemist. Physical chemistry and chemical physics make up the whole of science outside of biology, at the present day. A great deal has been heard of physical chemistry. With some modification of its fundamentals, it had come to stay. We must now all be chemists, for chemistry is *the* science of the whole of matter. Gravitation has shown us great things at great distances. Cavendish pushed down the law of gravitation to small distances, but now we must go on down to infinitely smaller distances in connection with chemical affinity, which Cauchy supposed could act at distances infinitesimal with regard to the wave-length of light. The physicist must bow to the chemist to investigate these things. The largest part of physical science is chemistry, and the chemistry of the future is the whole of physical science.

Sir Herbert Maxwell, in replying for the House of Commons, said that in spite of all the kindliness infused into his allusions to the House of Commons, Professor Thorpe had given the impression that the atmosphere of the House of Lords was a purer and a loftier one. And so it is, but is that independent of the fact that so many of those who sit there have passed through the purgatory of the Lower House? Such are Lord Blythswood, Lord Avebury, better known as Sir John Lubbock, and many others. When the connection between science and the Legislature was mentioned, he feared lest the proposer of the toast was going to contrast what was done in this country for science with what was done in other countries. At the present time, for example, he was chairman of a departmental committee to inquire into the administration of the meteorological grant, which amounts to £15,000. In the United States the grant for a similar purpose is a quarter of a million. Although all the members of the committee appointed by the Privy Council to inquire into the working and amendment of the Pharmacy Acts did not put the same construction on the evidence brought before them, each was ready to give to every other full credit for the faithful discharge of duty according to his lights. Had the report depended on himself alone, he would have felt serious misgivings, especially after many letters he had received from members of a very important profession, but he was much indebted to the Chemical Society for the aid rendered to him by its ex-President,

Professor Thorpe, its President-elect, Professor Tilden, and Dr. Stevenson. When it is considered how largely the use of poisonous substances has increased in agriculture, horticulture, and various other industries, he thought they were justified in coming to the conclusion that some relaxation of the restrictions imposed by the Pharmacy Act of 1868 had become urgent.

Sir W. T. Thiselton-Dyer said that it was with great pleasure that he proposed the toast of "Prosperity to the Chemical Society," especially as he had to couple with it the names of two great friends of his, those of the President, Professor Emerson Reynolds, and the Honorary Secretary, Professor Dunstan. To the former he owed much for introducing him many years ago to the society of the scientific men of the Irish capital, who were bound together by a *camaraderie* unknown in London. He understood that the President during the tenure of his office had travelled something like sixteen thousand miles in the performance of his duties. The Senior Secretary, whose scientific work he so highly appreciated, gives up his office after a decade spent in the service of the Society, and leaves work much more congenial to him to devote his energies to the task of co-ordinating the Imperial Institute into something useful to the Empire, in which he would have the hearty co-operation of Kew. There must be something in the science of chemistry which for its own sake can call forth such enthusiasm and energy. When the Society meets a century hence, he could conceive that they would look back on the chemistry of the present time much as the transcendental mathematician looks on the arithmetic of the Board school. The chemistry of to-day is probably only the expression of a particular view of material structure—a mere calculus which may be dispensed with. The dream of his old teacher, Sir Benjamin Brodie, may yet be realised, and we may not only be able to say what compounds are possible, but be able to predict their properties, their structure, their form. But what is to be said with regard to life? Lord Kelvin long ago suggested that it came from the stars. After some work with which Professor Dewar had kindly associated his name, he had no hesitation in saying that he could see no difficulty in protoplasm passing through stellar space even though it could not be reduced to chemical laws.

The President said he rose with very mingled feelings to respond. He did not know that he could claim that chemists as a body were particularly modest, but he thought that he might justly claim that the Society which was represented here to-night did admirable work and did it well. There was no harm in proclaiming that the Society was prosperous; its Fellows numbered 2471, and its income has reached the respectable sum of £6200, which has enabled it to print a very large amount of work contributed by its Fellows, many of whom, in addition

it has been able to aid in a material way in the prosecution of their researches. They had always the certainty that truth acquired for its own sake would become of ultimate value to the human race. Now nothing contributes so much to the success of work in any department of human knowledge as a good working hypothesis. It is therefore interesting to note that they were in a measure celebrating the Centenary of the promulgation of the Atomic Theory. That great inspiration of Dalton's with regard to the discrete nature of matter seems to have been first made known in a tentative form to a select audience of nine persons. Now the whole world is the audience of the philosopher. It was invented to explain the chemical laws then known, and had exercised a most profound influence on the progress of science. It was the germ of that molecular theory of matter which pervades all chemistry and physics at the present time. Physicists seemed to expect them to think that all light and leading flows through them and many considered that Dalton's theory has had its day, but he agreed with Lord Kelvin that it had a long day yet.

Professor Dunstan expressed the great gratification it had been to him to be officially connected for the last ten years with the Society, which continues to grow from year to year, and reflects not only the progress of English chemistry, but of the science of chemistry throughout the world. One circumstance he would always recall with the greatest pleasure, and that was the harmonious way in which the officers had always worked together in promoting the best interests of the Society. All acknowledge how much chemistry owes to Germany, and here to-night is to be seen, for the first time by the Society, the bust of Liebig, to whom, both as a discoverer and as a teacher, our science is indebted so much. This gift, which will soon adorn the rooms of the Society, they owed to the generosity of Dr. Messel.

The President-Elect, Professor Tilden, said that the pleasant duty of proposing the health of their guests, had been assigned to him. Beside those whom they had had the pleasure of hearing, he might mention that they had with them the Director of the National Physical Laboratory, who was, also, most appropriately President of the Physical Society, the President of the Pharmaceutical Society, and the President of the Institute of Chemistry. He could assure the last named that although at one time it was feared that the Institute of Chemistry might interfere with the progress of the Chemical Society, he could assure its President that the Chemical Society looked with friendly eyes on its efforts to raise the qualifications of professional chemists, and to inculcate among its members those professional feelings with which every well-organised profession ought to be animated.

A secret which he had reserved for himself had been let out by Professor Dunstan. The bust of Liebig which they saw was said to

be a faithful representation of the great master to whom the science of chemistry owed so much, and who was well-known in England forty-five years ago. Has he come back, like the statue of the commander in *Don Juan*, to remind us of our misdoings? For in 1837 Liebig wrote that he had been staying for a long time in England and had not learned much. He thought that could an opinion be obtained from him now it would be very different, for since that time vast revolutions had taken place. In this country we are always a little late in starting, but when we do start we do our work thoroughly; and he thought that the activity, energy, enthusiasm, and quality of the work done by the Society was not surpassed by any other society on the face of the globe. He had been instructed to couple with this toast the names of Mr. Kempe, Treasurer of the Royal Society, and that of his old friend and pupil, Mr. Swinburne, President of the Institution of Electrical Engineers. He might say that with regard to the Royal Society the Chemical Society looks towards it much as a daughter looks towards her mother even after she has left the parental roof. The acquisition of the three magic letters F.R.S. is still the ambition of all the young chemists of England, an ambition which has a very healthy influence as an incentive to the pursuit of scientific work. He hoped it would always be reserved as a prize for the successful worker, and awarded solely for additions to knowledge. Circumstances tempted him to ask them to join with this toast yet another well-known name, that of one of the Fellows of the Society, whose appearances are so rare that he comes almost with the prestige of a Foreign Member. All used to look upon Professor Lunge as an Englishman, but whatever he is now he trusted that he retained some kindly thoughts of by-gone days spent in England.

There were two reasons, Mr. KEMPE thought, why he had been asked to respond to this toast—one because he was the senior officer of the Royal Society present, and the other because he represented the law; but he was not on that account going to give them a speech of double length. To-night they had been brought together by the forces of chemical affinity, but soon the forces of dissociation must come into play; still, he ventured to hope that soon again the processes of synthesis would be re-established.

Mr. SWINBURNE said that it was very pleasant to have his old master, Professor Tilden, propose his name as one of their guests to-night. If, as a boy, he had ever any chemical microbes in him, it was by Professor Tilden that they had been fostered. Although all knew how unsafe it was to differ from Lord Kelvin on any point, he was going to claim chemical science as a small branch of that domain of science which he had the honour to represent, because the *Encyclopædia Britannica* says, and therefore it must be so, that all chemical action

is but electrolysis. The foundations of chemistry have, on the whole, been more secure than those of most other sciences during these troublous times. Chemists did not suffer so much as electricians did, for they used to have one fluid, then two fluids, and now no fluid. They had to master a new theory almost every week or two. If there was one piece of advice he might be allowed to give, it would be to stick fast to their atoms and molecules.

Professor Lunge said that he had been greeted by the President-elect as a guest, and in one sense he was so. He had the honour of being elected a Fellow of the Society thirty-five years ago, but had never been able until that day to be present at a single meeting. When he was elected he resided in the far north, and his visits to London were few and far between, and now that he was in Zurich they were naturally still more rare, yet he never came to London without looking to see whether he could not attend a meeting of the Society. Now to-day he had been able to attend the Annual General Meeting, and had hoped to be formally admitted a Fellow. He found, however, that that was against the Bye-laws, for it was only at Ordinary Scientific Meetings that Fellows could be admitted. He was therefore just where he was before, and so far entitled to be considered as a guest. Since the freedom of Zurich had been conferred upon him he had become a citizen of Switzerland, but he always felt himself to be what Professor Tilden called him—an English chemist. Whatever he had done he owed to his twelve years of English training, so he owed a debt of gratitude to this country, and he was glad to have this opportunity of saying so and of thanking them for the kind way in which he had been received.

Thursday, April 2nd, 1903. Professor W. A. Tilden, D.Sc., F.R.S., President, in the Chair.

Messrs. T. E. Wallis, R. C. Farmer, and H. W. Bywaters were formally admitted Fellows of the Society.

Certificates were read for the first time in favour of Messrs.:

William Godsell Burghard, 180, High Holborn, W.C.
Edwin Jesse Fairhall, 29, Winsham Grove, S.W.
Norbert Van Laer, 69, Calais Road, Burton-on-Trent.
Henry Wolff Levy, Chancery Lane, Melbourne.
Alfred Ernest Moore, B.A., B.Sc., St. John's College, Battersea, S.W.

George M. Norman, B.Sc., 5, Watford Villas, Battersea Park, S.W.
George Harry Parry, The Level, Brierley Hill, Staffordshire.
James C. Smith, B.Sc., 57, Great Ormond Street, W.C.

Of the following papers, those marked * were read:

***51. "The dioximes of camphorquinone, and other derivatives of *iso*nitrosocamphor." By M. O. Forster.**

The dioximes of camphorquinone, three of which were described by Manasse (*Ber.*, 1893, **26**, 243), have been obtained in purer condition, and the series of four completed. The following table summarises the chief characteristics of these substances:

	M. p.	$[\alpha]_D$ in alcohol.	$[\alpha]_D$ in 2 per cent. sodium hydroxide.	Precipitate with sodium hydroxide and ferrous sulphate.	C.c. of absolute alcohol at 20° required to dissolve 1 gram.
α-Dioxime ...	201°	−63·6°	−98·3°	Chocolate	40
β-Dioxime ...	248	—	−24·1	Chocolate	590
γ-Dioxime ...	135	+22·4	+12·6	None	1·0
δ-Dioxime ...	199	+75·5	+83·6	Chocolate	12·4

The *peroxide* of the dioximes, $C_{10}H_{14}O_2N_2$, obtained by oxidising them with potassium hypobromite, melts at 144·5°, and when reduced with zinc and acetic acid, yields the α-dioxime.

The *anhydride* of *iso*nitrosocamphor, $C_{20}H_{28}O_2N_2$, prepared by heating together the potassium and benzoyl derivatives of *iso*nitrosocamphor in benzene, is also formed when benzoyl chloride, acetyl chloride, phosphorus oxychloride, or acetic anhydride acts on the dry alkali derivatives. It melts at 187°, becoming transformed into the anhydride of α-camphornitrilic acid; a 2 per cent. solution in chloroform has $[\alpha]_D$ +141·7°.

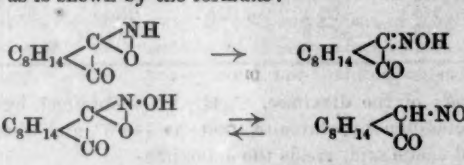
Two isomeric *compounds*, $C_{17}H_{18}O_5N_2$, melting at 136—137° and 152° respectively, are produced by the action of *m*-nitrobenzoyl chloride on an alkaline solution of *iso*nitrosocamphor. As in the case of the benzoyl derivatives, the substance of lower melting point is yellow, whilst the other is colourless. On hydrolysis, the former gives rise to a new modification of *isonitrosocamphor*, $C_{10}H_{15}O_2N$; this compound, which is still under investigation, melts at 114° and passes into the known isomeride between that temperature and 152°.

Discussion.

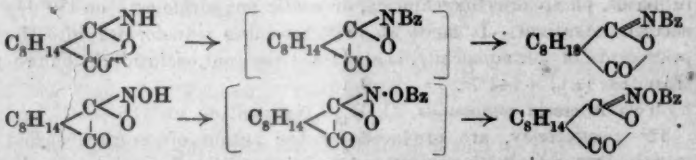
Dr. Armstrong pointed out that if Dr. Forster's discovery of a yellow benzoyl*iso*nitrosocamphor were taken into account, together with Miss Whiteley's recent important observations on the colour of oximic compounds, the absence of colour from *iso*nitrosocamphor and the dioximes could only be explained—if they were regarded as true oximic compounds—on the assumption that they were polymerised molecules; but he was of opinion that it was premature, at present, to accept the explanation afforded by the Hantzsch-Werner hypothesis of the isomerism subsisting among the dioximes. On various grounds, he held this hypothesis to be open to grave question. Even the structure of camphorquinone appeared to be by no means placed beyond doubt.

Dr. Silberrad asked whether the benzoylation of camphor*iso*imide had been tried in perfectly dry pyridine in place of the alkaline solution used in the Schotten-Baumann reaction, and stated that this modification had proved very useful in the benzoylation of compounds which undergo immediate hydrolysis in contact with water.

Dr. Lowry said that if the labile form of *iso*nitrosocamphor were regarded as an *iso*oxime, the isomerism described by Dr. Forster would correspond closely with that of the *normal* and *pseudo*-nitrocamphors, as is shown by the formulæ:



The formation of a colourless benzoate might then be regarded as being due, in each case, to the benzoylation of the labile form with an accompanying isomeric change of the Beckmann type:



Dr. Forster stated that the molecular weight of the new *iso*nitrosocamphor had not been determined, but that as soon as the necessary material had been accumulated the general behaviour of the substance would be more closely studied; Dr. Silberrad's suggestion relating to camphor*iso*imide would be adopted.

*52. "Reversibility of enzyme or ferment-action." By A. C. Hill

It has been shown previously that the hydrolysis of maltose to glucose by yeast extract in concentrated solution is incomplete, the phenomena being due to polymerisation of the glucose by a reversible process, and a point of equilibrium is approached which varies with the concentration of the total sugar. In further publications, it was also pointed out that the polymerisation of glucose resulted in the formation of isomeric sugars, and somewhat different results were obtained when Taka-diastase and the pancreatic ferments respectively were used instead of yeast extract. In every case, it was possible, by diluting solutions of the synthetical products, to hydrolyse these compounds back to glucose by the enzyme used in their synthesis. Further, it had been found that the synthetical products of the action with yeast extract are hydrolysed by Taka-diastase, and those of the action with Taka-diastase by yeast extract.

When the products of the synthetical change obtained by the use of yeast ferment, whilst still mixed with unchanged glucose, are fermented with *S. Marxianus*, only this hexose is fermented; but when a yeast containing maltase is employed, a part also of the synthetical product is fermented. Again, if the synthetical products in dilute solution are submitted to the hydrolytic action of yeast extract and then treated with *S. Marxianus*, the whole is fermented. The sugar that is not fermented either by *S. Marxianus* or by yeasts containing maltase has been separated and proves to be a new biose, which is called *revertose*. The other sugar, which is fermented by all yeasts containing maltase but not by *S. Marxianus*, is believed to be maltose, for although it has not been obtained pure, yet on fractionating mixtures of this sugar with revertose, specimens have been obtained in which the former sugar preponderates and of which the optical and other properties approach those of maltose. Its osazone crystallises in plates, whilst the corresponding derivative of revertose separates in needles. Revertose is formed in larger quantity, and the equilibrium point of glucose $\rightleftharpoons$ revertose is more favourable to the synthetical change than the equilibrium point of maltose $\rightleftharpoons$ glucose, which favours the hydrolytic reaction.

The products of the synthetical change with Taka-diastase are equally fermentable in part by all maltase-containing yeasts and, as previously indicated (*Proc.*, 1901, 17, 184) are readily rehydrolysed by the same ferments in dilute solution. These products have not been separated.

Since the first paper on this subject (*Trans.*, 1898, 73, 634), further observations of a similar nature have been made by the author and

others, and the number of ferments for which a reversible action has been noted has become extended. These results warrant the adoption of the hypothesis that all ferment actions are reversible.

Discussion.

Mr. A. R. Ling said that recent experiments on the action of various hydrolytic enzymes on polysaccharides had shown that hydrolysis was invariably accompanied by a reversed or synthetical action, Dr. Hill being the first to notice that this reversion occurred when a concentrated solution of *d*-glucose is submitted to the action of yeast-maltase.

In conjunction with Mr. B. F. Davis, he had obtained evidence that a certain amount of reversion occurred at a certain stage in the reaction between malt diastase and 3 per cent. starch paste.

The use of the term "reversion" was, however, scarcely justifiable, as in no case had reversion led to the regeneration of the original carbohydrate, the products being *iso*-sugars, as had been shown in certain instances by E. Fischer and E. F. Armstrong. As it was extremely unlikely that the same product was obtained from a given carbohydrate by the use of different enzymes, the name "revertose" seemed too general for any specific compound obtained in this way.

Dr. E. F. Armstrong remarked that the important question to be decided with reference to the synthetical action of enzymes was whether the sugar synthesised was identical or not with that normally hydrolysed by the enzyme, and expressed the view that, at present, the experimental evidence tends to prove that the synthesised biose and the hydrolysed biose bear the same relation to one another as do the α- and β-methyl glucosides. He thought that the portion of the material fermented by yeast was more likely glucose than maltose, and did not consider the evidence sufficient to establish the individuality of revertose as distinct from the *iso*maltose proved by Emmerling to be formed by the action of maltase on glucose.

Mr. J. L. Baker inquired whether any derivatives of revertose other than the phenylosazone had been prepared as, for example, the acetyl and benzoyl compounds. Was the evidence of the identity of revertose based solely on the physical constants and the osazone?

In reply, Dr. Croft Hill stated that revertose was obtained in white, crystalline, very hygroscopic crusts by dehydrating the vitreous mass in which it first separates from its alcoholic solution. It still contained a little ash, but the osazone was obtained quite pure.

Revertosazone is readily distinguished from Fischer's *iso*maltosazone by the fact that it is optically inactive, whereas Fischer's *iso*maltosazone was dextrorotatory.

The fermentation experiments with maltase-containing yeasts on the one hand, and with *S. Marxianus* on the other were conducted on parallel lines, analyses being made at every step. The difference in the two cases could only be explained by the fact that in the former case a part of the synthetical product was fermented.

The view put forward by one school of chemists in Germany, that the action of ferments was not truly reversible, but that the substance synthesised is always different from the substance hydrolysed, is untenable, for in every case the synthesised substance can again be hydrolysed by the ferment which produces it.

He considered it likely that conditions of equilibrium may favour such a practical outcome, and the synthetical process in the organism may have such a relationship to the analytical process, but, theoretically, each component of the process is reversible in the strictest chemical sense.

*53 "Discoloured rain." By E. G. Clayton.

The rain which fell for some hours on Sunday, February 22nd, 1903, in all counties south of the Thames, and elsewhere, as at Clare in Suffolk, Oswestry in Salop, and on the Continent, as at Bochum in Westphalia, was turbid and discoloured, soiled window glass to an unusual extent, and left, on exposed surfaces, a greyish-brown or terra-cotta-coloured deposit. The wind prevailing at the time was very high, and generally westerly or south-westerly. It has been suggested that the deposit was of volcanic origin, and probably due to the West Indian eruptions.

The following results were obtained with a specimen of the rain collected by Mr. R. Pound at Ashbury, near Shrivenham, Berkshire.

Chemical Examination.—After five days, the water remained opalescent and yielded an extremely fine, light brownish-red sediment:

	Parts in 100,000.		Parts in 1,000,000.
(*a*) Dissolved solids (dried at 150°)	25·1	Ammonia (free and saline)	0·95
(*a*) Dissolved solids (after ignition)	21·1	Ammonia (on boiling with alkaline permanganate)	0·15
(*b*) Suspended matter	23·6		
Chlorine	2·0		

The residue (*a*), after evaporation, blackened on ignition with an odour of burning wood, and, on further heating, the carbon soon disappeared. The inorganic matter was mainly calcium carbonate; alkaline chlorides and iron compounds being also present.

The suspended matter, which contained a mere trace of carbonate, was almost insoluble in dilute acids, but decomposed on warming with moderately concentrated sulphuric acid; its chief components were silica (67·5 per cent.), alumina and ferric oxide (14·1 per cent.), and volatile matter (12·4 per cent.). The separated silica was perfectly white, and the volatile matter principally of organic origin.

The great differences between this specimen and ordinary rain water, especially as regards the proportions of chlorine, dissolved solids, and suspended substance, are sufficiently obvious.

Biological Examination.—One c.c. of the water, by plate-cultivation on nutrient gelatin at 20—22°, yielded, by the fourth day, 420 bacterial colonies. Of these, 19 were non-liquefying, iridescent expansions of irregular outline, having the characters of *Bacillus fluorescens non-liquefaciens*; the rest, which were sharply-outlined, circular, pearly dots, resembled *Bacillus liquefaciens*, and began to liquefy the gelatin on the third day. After incubation for 24 hours at 38°, 1 c.c. of the water showed, in 5 days, only 33 bacterial colonies (*Bacillus subtilis* ?).

Microscopical Examination of the Sediment.—The particles, which ranged in size from 0·001 to 0·005 mm., were yellow or brown, resembling those of clay. This similarity was noticed by Professor Bonney in a recently published letter describing some specimens of the deposit which he had received. In the sediment now under discussion, there were no vitreous, and very few angular, particles: between crossed Nicols prisms, the field was faintly illuminated. No pollen granules could be distinguished (although these appear to have been observed at Denchworth, Berkshire). The analysis, however, clearly indicates that some organic matter was present, both in solution and also in suspension in an exceedingly fine state of division.

The results show that this rain was charged with wind-borne dust, which in the specimen examined was a marly and ferruginous clay, mixed with organic refuse, perhaps of animal, as well as vegetable, origin; the calcareous matter had mainly dissolved in the water, which contained carbon dioxide, whilst the argillaceous and siliceous portions were carried in suspension. This composition is just such as might be expected in dust blown from the Jurassic and Cretaceous drift of Wessex roads and lanes. It is, therefore, not necessary to assume that the dust was conveyed either from remote regions or across the sea, and there are good grounds for supposing that, if a series of analyses had been made of the rain and sediment from different places, the figures would have reflected in some degree the local characteristics of the soils and subsoils of areas situated at a distance of a few miles, or even less, immediately to the west or south-west of those places. In a marly district, the ratio of

calcareous matter to clay and silica would be high; where loam prevailed, fine siliceous sand would predominate; further west, felspar crystals and ferro-magnesian minerals would abound, possibly with less organic matter; from highly cultivated tracts, pollen granules might arise, and so on. Ashbury is situated partly on the Upper Greensand and partly on the chalk, and in the vicinity there are extensive areas of clay and chalk. An analysis by Mr. R. A. Earp (*Nature*, 1903, 67, 414) of matter deposited by the rain, which fell on the same day at Buckfastleigh, Devon, showed that the sediment there contained less silica and more organic matter than the deposit examined by the author.

Discussion.

Dr. H. R. Mill said that he was investigating the fall of dust on February 22nd from a meteorological point of view in conjunction with Mr. Lempfert of the Meteorological Office, and Mr. Clayton's theory of the local origin of the dust would be tested before long by the examination of fifty specimens obtained from rainfall observers and others in many parts of England and Wales and some places abroad, this work having been undertaken by the Geological Survey. The magnitude of the dust-fall made it difficult to accept this hypothesis without very strong proof. In the south of England and in Wales, the dust, which was remarkably uniform in appearance, had fallen either dry or in rain over a space of 300 miles from west to east and 200 miles from south to north, whilst traces had occurred at intervals over the whole area of the British Isles from Scilly to Shetland. The fact that similar dust was observed on the same day over the greater part of the Channel Isles, Belgium, and Holland, and at many places in Germany, Switzerland, and Austria, as well as in the North Atlantic, whilst dust-storms prevailed off the coast of Africa, made a common origin seem very probable, and perhaps this was a case of far-travelled, wind-borne dust.

54. "The absorption spectra of nitric acid in various states of concentration." By W. N. Hartley.

Photographs have been obtained of the spectra of nitric acid in eight different states of concentration, varying from 89·6 per cent. of HNO_3 (sp. gr. 1·490 at 15°) to 20·31 per cent. (sp. gr. 1·127 at 15°).

Acid of sp. gr. 1·490 transmits a very short spectrum, which is greatly lengthened by dilution. The acid of sp. gr. 1·432 (72·57 per cent.) transmits a longer spectrum than the 20·31 per cent. solution, but this is shortened on dilution; in like manner, weaker acids down to that of

sp. gr. 1·127 behave in the same way, but here the dilute solution transmits a spectrum nearly as long as the strong acid. From this point onwards, an absorption band makes its appearance. If water acted simply as a diluent, dilution would cause an increase in the length of the transmitted spectra which would be proportional to the quantity of water added. There is evidently some chemical action between the water and the acid, but this action with acid of sp. gr. 1·490 is different from that with acid of sp. gr. 1·432 or any less concentrated acid. Hence it is probable that in strong nitric acid, the molecule is either polymerised to $n(HNO_3)$ or resolved into a compound of the nature of N_2O_5,H_2O. The acid of sp. gr. 1·490 might be represented either as a mixture, $N_2O_5,H_2O + H_3NO_4$, or as a compound, $H_3N_3O_9,H_2O$. The weaker solutions of the acid probably contain hydrates. Evidence is afforded that the strong acid contains two different substances, one of which acts on caustic lime whilst the other does not.

55. "Salts of an isomeric mercaptoid form of thioallophanic acid, and a new synthesis of alkyl iminothiocarbamates." By A. E. Dixon.

By heating ethyl chlorocarbonate with phenylthiourea on the water-bath in presence of benzene, carbon dioxide was expelled and a yellow syrup formed, the latter being the hydrochloride of Bertram's (*Ber.*, 1892, **25**, 55) ethyl iminophenylthiocarbamate, $NPh{:}C(NH_2)\cdot SEt$ or $NHPh\cdot C(NH)\cdot SEt$: – $NHPh\cdot C(NH)\cdot SH + EtO\cdot COCl = CO_2 + NHPh\cdot C(NH)\cdot SEt,HCl$. With methyl chlorocarbonate, under like conditions, the hydrochloride of methyl iminophenylthiocarbamate was obtained.

p-Tolylthiourea and methyl chlorocarbonate yielded the *hydrochloride* of *methyl imino*-p-*tolylthiocarbamate*, $NH(C_7H_7)\cdot C(NH)\cdot SMe,HCl$, in long, white prisms melting at 154—155°; the corresponding *base* could only be obtained as an oil. From *o*-tolylthiourea, by heating with methyl chlorocarbonate, a syrupy hydrochloride was produced; the corresponding free base, liberated by the cautious addition of alkali, crystallised from light petroleum in white lozenges melting at 101—102°.

Methyl iminoallylthiocarbamate, $NH(C_3H_5)\cdot C(NH)\cdot SMe$, was not precipitated by alkali from the aqueous solution of its hydrochloride; the *picrate* formed yellow, hair-like needles melting at 149—150° (corr.).

Thiocarbanilide, when heated with ethyl chlorocarbonate, affords a carbethoxy-derivative melting at 95°, which is non-basic and appears to have the constitution $NHPh\cdot CS\cdot NPh\cdot CO_2Et$ (Seidel, *J. pr. Chem.*,

1885, **32**, 262); the *methyl* homologue crystallises from alcohol in white needles melting at 105°.

Experiments conducted in the cold led to results entirely different from those just mentioned; thus, methyl chlorocarbonate, when allowed to remain in contact with finely-powdered, monosubstituted thioureas, gradually reacted, without evolution of gas, to form additive products; these substances, which dissolved freely in water, yielding very acid solutions, proved to be hydrochlorides. By neutralising with alkali, or even by prolonged boiling of their aqueous solutions, the acid could be readily withdrawn, thereby leaving crystalline solids, sparingly soluble in water and melting, with decomposition, at relatively high temperatures.

The following compounds of this class are described:

Methyl phenylthio-ψ-allophanate, $NHPh{\cdot}C(NH){\cdot}S{\cdot}CO_2Me$, brilliant prisms, m. p. 166—167° (corr.); *methyl* p-*tolylthio-ψ-allophanate*, $NH(C_7H_7){\cdot}C(NH){\cdot}S{\cdot}CO_2Me$, flattened, white prisms, m. p. 175—176° (corr.); *methyl* o-*tolylthio-ψ-allophanate*, colourless prisms, m. p. 175—176° (corr.).

Thiourea itself also affords, with chlorocarbonates, two distinct classes of derivatives.

Ethyl thio-ψ-allophanate, $NH_2{\cdot}C(NH){\cdot}S{\cdot}CO_2Et$, is formed when thiourea and ethyl chlorocarbonate are very cautiously warmed in presence of benzene or, preferably, absolute alcohol, or by adding carbonyl chloride, in toluene, to thiourea suspended in absolute alcohol; its hydrochloride forms beautiful, transparent octahedra melting at 116—117° with effervescence, due to the escape of carbon dioxide; the fusion product, a viscid syrup which appears to be identical with that obtained by heating thiourea with the chlorocarbonate, is the *hydrochloride* of *ethyl iminothiocarbamate*, $NH_2{\cdot}C(NH){\cdot}SEt$.

Methyl thio-ψ-allophanate, like the ethyl homologue, is readily soluble in water; its hydrochloride forms a white, crystalline powder, which melts at 89—90° with effervescence and is thus converted into *methyl iminothiocarbamate hydrochloride*, $NH_2{\cdot}C(NH){\cdot}SMe,HCl$; this product, when obtained by heating thiourea and methyl chlorocarbonate in presence of benzene, separates as an oil, which subsequently changes to a crystalline solid melting at 59—60°. Both this and the corresponding ethyl derivative give mercaptan with cold alkali hydroxides, and yellow precipitates with alkaline lead and silver salts; the thio-ψ-allophanic compounds, on the other hand, yield no mercaptan with alkali, and are simply desulphurised by treatment with the metallic salts.

56. "Derivatives of *o*-aminobenzophenone and *p*-aminobenzophenone." By F. D. Chattaway.

Considerable quantities of *o*-aminobenzophenone and *p*-aminobenzophenone having been prepared in an investigation of the transformation of dibenzanilide into these substances (this vol., 57), a number of their nitrogen halogen derivatives have been studied. These are formed by the action of aqueous hypochlorous or hypobromous acid on the acylaminobenzophenones dissolved in alcohol, but in order to obtain products that can be crystallised it is necessary to work at a low temperature and to guard carefully against any liberation of free halogen. The nitrogen halogen derivative can be extracted with chloroform and recrystallised from light petroleum or a mixture of this and the preceding solvent.

Acetyl-o-chloroaminobenzophenone, $Ph{\cdot}CO{\cdot}C_6H_4{\cdot}NClAc$, colourless, flattened prisms with domed ends, m. p. 102°; *acetyl-o-bromoaminobenzophenone*, $Ph{\cdot}CO{\cdot}C_6H_4{\cdot}NBrAc$, short, transparent, yellow prisms, m. p. 121°; *propionyl-o-chloroaminobenzophenone*, $Ph{\cdot}CO{\cdot}C_6H_4{\cdot}NCl{\cdot}COEt$, clusters of colourless, flattened prisms, m. p. 107°; *propionyl-o-bromoaminobenzophenone*, clusters of yellow plates, m. p. 90°; *benzoyl-o-chloroaminobenzophenone*, $Ph{\cdot}CO{\cdot}C_6H_4{\cdot}NCl{\cdot}COPh$, colourless, rhombic plates, m. p. 98°.

Acetyl-p-chloroaminobenzophenone, groups of colourless, slender, flattened plates, m. p. 124°; *acetyl-p-bromoaminobenzophenone*, groups of pale yellow, six-sided plates, m. p. 151°; *propionyl-p-aminobenzophenone*, colourless, elongated plates, m. p. 139°; *propionyl-p-chloroaminobenzophenone*, colourless, flattened prisms, m.p. 129°; *propionyl-p-bromoaminobenzophenone*, $Ph{\cdot}CO{\cdot}C_6H_4{\cdot}NBr{\cdot}COEt$, pale yellow plates, m. p. 123°; *benzoyl-p-chloroaminobenzophenone*, clusters of colourless plates, m. p. 107°; *benzoyl-p-bromoaminobenzophenone*, clusters of yellow, rhombic plates, m. p. 93°.

The transformation which occurs when these substituted nitrogen chlorides and bromides are heated above their melting points is accompanied by considerable decomposition, and dark, impure products are obtained. When the compounds are dissolved in acetic acid and warmed, the halogen passes from the nitrogen into the ring in the usual manner.

57. "Action of caustic alkalis on cinnamic acid dibromide and its esters." By J. J. Sudborough and K. J. Thompson.

Good yields of *a*-bromocinnamic and *a*-bromo*allo*cinnamic acids may be obtained under suitable conditions by the action of caustic alkalis on

cinnamic acid dibromide and its esters. The relative amounts of the two acids produced depend mainly on the employment either of the acid dibromide or of an ester, and, to a less extent, on the alkali and the solvent; the yield of α-bromo-acid (m. p. 131°) is always greater when an ester is employed. In no case has it been found possible to obtain only the normal product, namely, α-bromo*allo*cinnamic acid. The two acids are readily separated by the aid of their barium salts.

A bye-product often obtained is ω-bromocinnamene, CHPh:CHBr, and this appears to be a primary decomposition product of the acid dibromide, and is therefore not obtained indirectly from one or the other of the α-bromo-acids, as stated by Barish. The addition of bromine to ethyl cinnamate and the transformation of the *allo*-acid into the α-bromo-acid have also been studied.

58. "The composition of Caro's acid." By T. S. Price.

Armstrong and Lowry (*Proc. Roy. Soc.*, 1902, 70, 94) have shown that, in dilute solution, Caro's acid is to be represented either by the formula $H_2S_2O_4$, assuming that the acid is dibasic, or by H_2SO_5 if the compound is regarded as monobasic. Since this conclusion is opposed to the results formerly obtained by the author (*Ber.*, 1902, 35, 292), a new series of experiments on the increase of acidity has been undertaken, and the revised data now agree with the results of these investigators, although the method employed in the author's experiments was less accurate.

The increase in acidity was formerly estimated by means of barium hydroxide solution, but Caro's acid, when neutralised by this alkali, is decomposed, 1 mol. of $H_2S_2O_9$ giving rise to 2 mols. of H_2SO_4, so that the actual increase is twice the calculated quantity. If sodium hydroxide is employed, the acid is not decomposed, and the normal increase in acidity is indicated.

This difference in the behaviour of the two alkalis is also suggested by a determination of the ratio of iodine equivalent to increase in acidity, the mean values found being 4·74 and 2·75 for sodium hydroxide and barium hydroxide respectively. The deviation from the corresponding theoretical numbers (5·18 and 2·59) is probably due to experimental errors.

ADDITIONS TO THE LIBRARY.

I. Donations.

Mulder, Genardus Joannes. Bijdragen tot de geschiedenis van het scheikundig gebonden water (being *Derde stuk, derde deel* of *Scheikundige verhandelingen en onderzoekingen*). Rotterdam 1864. From Prof. Tilden, F.R.S.

Holleman, Arnold Frederick. A text-book of inorganic chemistry, rendered into English with the cooperation of the author by Hermon C. Cooper. ill. New York and London 1902. From the Publishers.

Armsby, Henry Prentiss. The principles of animal nutrition with special reference to the nutrition of farm animals. New York and London 1903. From the Publishers.

Chemical Technology or Chemistry in its applications to arts and manufactures, with which is incorporated Richardson and Watts' Chemical Technology. Edited by Charles Edward Groves and William Thorp. Vol. III. Gas lighting, by Charles Hunt. ill. London 1900. From the Publishers.

Chemical Technology or Chemistry in its applications to arts and manufactures, with which is incorporated Richardson and Watts' Chemical Technology. Vol. IV. Edited by William Joseph Dibdin. Electric lighting, by A. G. Cooke, Photometry by William Joseph Dibdin. ill. London 1903. From the Publishers.

Sprengel, Hermann. The discovery of picric acid (Melinite, Lyddite) "as a powerful explosive" and of cumulative detonation with its bearing on wet guncotton. Second edition. London 1903. From the Author.

Hoff, Henricus Jacobus van't. Vorlesungen über theoretische und physikalische chemie. Zweites Heft. Die chemische Statik. 2nd ed. ill. Braunschweig 1903. From the Author.

II. By Purchase.

Buchner, Eduard, Buchner, Hans, and Hahn, Martin. Die Zymasegärung, Untersuchungen über den Inhalt der Hefezellen und die biologische Seite des Gärungsproblems. München 1903.

Lassar-Cohn, ——. Arbeitsmethoden für organisch-chemische Laboratorien, ein Handbuch für Chemiker, Mediziner, und Pharmazeuten. 3rd ed. Hamburg 1902.

Vogl, August Emil. Die wichtigsten vegetabilischen Nahrungs- und Genuss-mittel, mit besonderer Berücksichtigung der mikro-

skopischen Untersuchung auf ihre Echtheit, ihre Verunreinigungen und Verfalschungen. ill. Berlin 1899.

Frühling, Robert. Anleitung zur Untersuchung der für die Zuckerindustrie in betracht kommenden Rohmaterialien, Produkte, Nebenprodukte, und Hilfssubstanzen. 6th edition. ill. pp. xxi—505. Braunschweig 1903.

Lindner, Paul. Atlas der mikroskopischen Grundlagen der Gärungskunde mit besonderer Berücksichtigung der biologischen Betriebskontrolle. 111 Tafeln mit 418 Einzelbildern. Berlin 1903.

Borchers, Wilhelm. Das neue Institut fur Metallhüttenwesen und Elektrometallurgie an der königlichen technischen Hochschule zu Aachen (Abschnitt. Elektrische Messinstrumente). Halle 1903.

Borchers, Wilhelm. Elektro-Metallurgie des Nickels. ill. (*being* part of Bd. VI. Monographien über angewandte Elektrochemie. Halle 1903.

Roesler, Leonhard. Mittheilungen über die Arbeiten der K.K. chemisch-physiologischen Versuchs-station für Wein- und Ostbau zu Klosterneuburg bei Wien bis Ende Juli 1902. Heft. VI. ill. Wien u. Leipzig 1902.

Glasgow. Corporation Water Works. Reports on the supply of water to the city. 1853—1855.

At the next ordinary meeting, on **Wednesday**, April 22nd, at **5.30** p.m., there will be a ballot for the election of Fellows, and the following papers will be communicated:

"The velocity and mechanism of the reaction between potassium ferricyanide and potassium iodide in neutral aqueous solution." By F. G. Donnan and R. de Rossignol.

"A microscopic method of determining molecular weights." By G. Barger.

"Note on the spectrum of pilocarpine nitrate." By W. N. Hartley.

"Isomeric change of dipropionanilide into propionyl-*p*-aminopropiophenone." By F. D. Chattaway.

CERTIFICATES OF CANDIDATES FOR ELECTION AT THE NEXT BALLOT.

N.B.—The names of those who sign from "General Knowledge" are printed in *italics*.

The following Candidates have been proposed for election. A ballot will be held on Wednesday, April 22nd, 1903.

Adshead, Henry Guest,
Heysham, Wimbledon Park, Wimbledon.

Analytical Chemist. Analytical Chemist and Assayer. Four years assistant to Mr. Leo Taylor, F.I.C., Public Analyst. Four years chief assistant to Mr. J. P. Norman, F.C.S. Gas Examiner under the London County Council.

John P. Norman.	*J. H. Coste.*
Charles Watson.	*Otto Hehner.*
Frank Clowes.	*H. Royal Dawson.*
R. Grimwood.	*Arthur J. Stacey.*

Alton, William Lester St. John,
Dungarvan, Putney Heath, S.W.

Chemical Student. Associate of the Institute of Chemistry. Student at University College, Gower Street, W.C. I desire the publications of the Society.

William Ramsay.	Edward C. Cyril Baly.
J. Norman Collie.	Morris W. Travers.
F. G. Donnan.	

Atkinson, Harford Montgomery,
32, Bagnall Road, Milton, Staffordshire.

Chemist to the British Aluminium Co., Ltd. (Milton Works). Studied Chemistry at University College, Aberystwyth, and graduated

B.Sc., London Univ. Worked for two years at Göttingen Univ. under Prof. Wallach, and gained the Dr. degree with a Thesis entitled "Beiträge zur Kenntniss der Oxaline." Worked for the British Aluminium Co. at Larne and Milton.

Arthur W. Warrington.	Edgar Neumann.
H. Lloyd Snape.	*J. J. Sudborough.*
J. Alan Murray.	*H. P. Bell.*

Bibby, R. Gordon,
New College, Oxford.

Studying Chemistry for Final Honour Schools, Oxford, and proposing to read for the Bar.

William Odling.	J. E. Marsh.
W. W. Fisher.	H. L. Bowman.
John Watts.	Henry A. Miers.
V. H. Veley.	A. F. Walden.

Blackshaw, George Neville,
Agricultural College, Aspatria, Cumberland.

Lecturer in Chemistry. Graduate (B.Sc.) of the University of Wales. Since January, 1902, Lecturer in General and Agricultural Chemistry at the Agricultural College, Aspatria, Cumberland.

Alexander Lauder.	John Frank Blackshaw.
John Golding.	Chapman Jones.

M. J. R. Dunstan.

Calvert, Harry Thornton,
West Riding of Yorkshire Rivers Board.

Chief Chemical Assistant to West Riding of Yorkshire Rivers Board. Joint author of various papers in *Proc.* and *Trans. Chem. Soc.*, 1896, 1898, 1900, 1901. Author of "Die Dielectricitätsconstante des Wasserstoffsuperoxyds" (*Annalen der Physik*, 1900, **4**, I, p. 483); "Die Alkalisalze des Hydroperoxyds" (*Zeitschr. f. phys. Chem.*, **38**, 5, 1901, p. 513), &c. Late 1851 Exhibition Scholar (1898—1901). Late Demonstrator in Chemistry at the Yorkshire College, Leeds. B.Sc. (Vict.) Hons. in Chemistry. Ph.D. (Leipzig University). A.I.C.

Arthur Smithells.	I. Patchett.
J. B. Cohen.	H. M. Dawson.
A. Turnbull.	*Thomas Fairley.*

Caudwell, Ben,
28, Wigfull Road, Sheffield

Student. B.A. (London), 1895. Have been Schoolmaster (secondary).

At present studying Chemistry at University College, Sheffield. Am desirous of obtaining the publications of the Society.

W. Carleton Williams.	Percy P. Phillips.
George Young.	Ernest Witham.
William H. Oates.	S. Irwin Crookes.

Divine, Thomas,

11, Spencer Place, Roundhay Road, Leeds.

Medical Practitioner. M.B., C.M. (Glasgow). Student of Chemistry, Glasgow University, and at Yorkshire College, Leeds. Interested in Public Health, and desirous of keeping in touch with Chemical Investigation.

T. Stratford Logan.	H. D. Dakin.
H. M. Dawson.	*J. B. Leathes.*

R. H. Aders Plimmer.

Eastwood, Arthur William,

Newton College, S. Devon.

B.A. (Camb.). Teacher of Chemistry at above College. Desirous of obtaining the literature of the Society.

F. W. Dootson.	R. H. Adie.
K. C. Browning.	*T. B. Wood.*

R. A. Berry.

Edgerton, John Percy,

39, White Hart Lane, Barnes, S.W.

Analytical Chemist, Assayer, and Gas Examiner. I was Assistant for three years to Leo Taylor, Esq., F.I.C., Public Analyst and Assayer; for 1 year in the laboratory of the Sheffield United Gas Light Co.; for 3½ years to W. C. Young, Esq., F.I.C., F.C.S., Public Analyst. I am Gas Examiner under the London Council; to the Urban District Council of Sunbury-on-Thames, and to the Brentford Gas Co.

John T. Sheard.	J. H. Coste.
John W. Heath.	*Vivian B. Lewes.*
Robert N. Lennox.	*James D. Kettle.*
R. Grimwood.	*E. T. Shelbourn.*
Frank Clowes.	*Wm. Jno. Livingston.*

Fletcher, Alan,

132, Holland Road Kensington, W.

Research Chemist. For three years student in Chemical Depart-

ment at Royal College of Science. Now Chemist in the laboratory of Messrs. Oppenheimer, Son, and Co.

William A. Tilden. H. Burrows.
W. Palmer Wynne. G. T. Morgan.
M. O. Forster. G. S. Newth.

Gough, Henry,

c/o John Lovibond and Sons, Limited, Greenwich, S.E.

Brewer and Analyst. Have obtained the Hons. Certificate and also the 1st Prize and Silver Medal of the City and Guilds for brewing. Have passed examinations in chemistry under the Board of Education. A student for three and a half years in the Brewing Department of the Manchester School of Technology. A former student in the Manchester Grammar School.

William J. Pope. F. S. Sinnatt.
Jas. Grant. S. J. Peachey.
L. G. Radcliffe. Francis Jones.

Howsam, George,

School of Science, Art, and Technology, Peterborough.

Lecturer in Chemistry, School of Science, Art, and Technology, Peterborough. Inter. B.Sc., London, First Division. Been for three years in the Laboratory with the Public Analyst of Borough and County Soke of Peterborough.

William Elborne. Chapman Jones.
James C. Philip. John B. Coppock.

W. Palmer Wynne.

Jones, Alfred Owen,

18, Queen's Gardens, Tetherdown, Muswell Hill.

Student of Chemistry for three years at University College. Tuffnell Scholar. Am leaving College to take up a position as Works Chemist, and wish to keep informed as to the progress of Chemical Science.

Edward C. Cyril Baly. Morris W. Travers.
William Ramsay. J. Norman Collie.

Samuel Smiles.

Kerr, James Stewart,

The Grove, Ladywood Road, Birmingham.

Science Teacher. A.R.C.Sc. (London) in Chemistry. Formerly Science Teacher at Whitehead Road, Birmingham. Science Master,

Methodist College, Belfast. Have done, and am doing, work on the bleaching of farinaceous foods.

W. Palmer Wynne. G. T. Morgan.
M. O. Forster. J. C. Philip.

Chapman Jones.

Kirkby, William,

Winster House, Thornfield Road, Heaton Moor, Stockport.

Analytical Manufacturing Chemist. Lecturer in Pharmacognosy in the Owens College for eleven years. Joint author of "Arsenical Poisoning in Beer Drinkers." Author of "The Evolution of Artificial Mineral Waters."

Wyndham R. Dunstan. W. H. Perkin, jun.
Harold B. Dixon. G. H. Bailey.

W. A. Bone.

Lock, John George Collcutt,

17, Berners Street, Oxford Street, W.

Engineering Chemist. In evening class two hours a week during six months studying Metallurgy at King's College, and at present engaged at Metallurgical work. Desirous of obtaining best current chemical literature and use of Reference Library.

A. K. Huntington. H. A. Thiersch.
Arthur C. Claudet. *Francis H. Carr.*

C. H. Desch.

Pond, George Gilbert,

State College, Pennsylvania.

Professor of General Chemistry, Pennsylvania State College. Student at Amherst College, 1878—81; Student at the University of Goettingen, 1881—82; Instructor in Chemistry, Amherst College, 1883—88; Received degree M.A., Amherst College, 1884; Student at the University of Goettingen, 1 semestre, 1885; Professor of Chemistry, The Pennsylvania State College, 1888; Received degree, Ph.D., Amherst College, 1889; Student at the University of Berlin, 1893—94; Dean of the School of Natural Science, The Pennsylvania State College, 1896.—

Jas. Lewis Howe. F. P. Venable.
Chas. Baskerville. Leonard P. Kinnicutt.

Clifford Richardson.

Pitt, Arthur Ernest,

66, Abbott Road, Bromley, E.

Chemist. Studied Chemistry and Allied Subjects for 6 years at

the East London Technical College under Professor J. T. Hewitt, being for some time his private assistant. Recipient of two Special Grants from London County Council for Research Work. For 2½ years Chemical Assistant to F. W. Mott, M.D., F.R.S., at the London County Asylum's Pathological Laboratory at Claybury. At present Research Chemist in Messrs. W. J. Bush & Co.'s Laboratory, Hackney, E. Joint Author in the following communications: "Phenetol azophenols" (*Proc. Chem. Soc.*, June, 1897). "Ueber die Salz- und Hydrat-Bildung der Azophenole" (*Ber. deut. Chem. Ges. Bd.*, 31). "The Condensation of Oxalic Acid and Resorcinol" (*Trans. Chem. Soc.*, 1899).

Edgar S. Barralet. de Bush.
J. T. Hewitt. O. J. Silberrad.

J. McCrae.

Pitt, Harold Russell,

8, Church Lane, Charlton, S.E.

Chemist. Second Assistant Chemist and Metallurgist in Royal Laboratory Department, Woolwich Arsenal. In laboratory of H. H. Smith, Esq., F.I.C., for twelve years. Lecturer in Chemistry at Dartford Technical Institute. Assistant lecturer in Department of Chemistry and Metallurgy, Woolwich Polytechnic, under J. B. Farlie, Esq., F.C.S. Pupil of J. B. Farlie, Esq., F.C.S., in Royal Arsenal and Polytechnic Science Schools.

J. B. Farlie. W. Lambert.
R. J. Redding. *W. Kellner.*
A. H. Mundey. *W. H. Deering.*

T. H. Dodd.

Porter, Robert James,

11, Arlington Street, Hull.

Schoolmaster. Successes: Board of Education, Honours Theor. Inorg. Chem. and Honours at Inter. Sc. (Lond.). But chiefly I wish to keep up to date in knowledge of recent work in all branches of Chemistry.

Fras. A. Drake. Thomas Luxton.
Thos. A. Nightscales. Arthur Brooke.

W. H. Templeman.

Robertson, Frederick,

The Hewan, Bearsden, Glasgow.

Analytical Chemist, 128, Wellington Street, Glasgow. Formerly Assistant Chemist, Anderson's Medical School, Glasgow. Lecturer

in Chemistry, Western Medical School, Glasgow. Analytical Chemist and Assayer.

Edmund J. Mills. Thomas Gray.
W. Shepperson. *G. G. Henderson.*
James Robson.

Robinson, Archibald Louis,
40, Trinity College, Dublin.

Student. First Scholar in Experimental Science (Dub. Univ.). Senior Moderator and Large Gold Medallist in Experimental Science (Dub. Univ.). B.A. (Dub. Univ.).

J. Emerson Reynolds. Wm. Cecil Ramsden.
Emil A. Werner. *Richard J. Moss.*
W. E. Adeney.

Roose, Fitzroy Owen Jonathan,
Marlow, Oxford Road, Bournemouth, and 49, Hill Street, Mayfair, W.

Electrical Engineer. Associate of Institution of Electrical Engineers. Passed Examination Advanced Chemistry, Science and Art Dept. Assistant Electrical Engineer, Corporation of Bournemouth. Am anxious to keep myself abreast of the modern developments of Physical Chemistry, particularly that bearing on Electricity, to obtain the Journal of the Society, and attend its meetings.

Hugh Erat Harrison. S. Russell Wells.
W. J. Cousins. M. O. Forster.
Frank E. Weston.

Sawdon, Ernest William, B.Sc.,
2, Esk Terrace, Whitby.

Science Master in Friends' School, Saffron Walden, Essex. Have been engaged in teaching since September, 1898. Bachelor of Science (Victoria), 1898. Educated Owens College (1895—1898).

Harold B. Dixon. D. L. Chapman.
W. H. Perkin, jun. Norman Smith.
E. D. Walrond. G. H. Bailey.
W. A. Bone.

Siddle, George.
Middleton-One-Row, R.S.O.

Analytical Chemist. 20 years' experience in Analytical work in

Iron and Steel Works, Chemical and Smelting Works, and in Manufacturing Chemistry.

J. E. Stead. G. H. Saniter.
H. Frankland. *C. H. Ridsdale.*
John Pattinson.

Stevens, Montague White,

2, Richmond Place, Lillie Road, London, S.W.

Assistant Chemist with Messrs. Stanger and Blount of Broadway, Westminster. 3½ years as a Student at Royal College of Science, London, chiefly in Chemistry. A.R.C.Sc. in Chemistry (June, 1902), A.I.C. (Jan., 1903).

William A. Tilden. G. T. Morgan.
M. O. Forster. H. Burrows.
Chapman Jones. J. C. Philip.
W. Palmer Wynne.

Stevenson, Henry Edward,

5, Turner's Road, Bow, London.

Chemist. For six years a student at the East London Tech. Coll., part of the time as private assistant to the Professor, Dr. Hewitt. For two years chemist in Messrs. G. Clark & Son's Sugar Works. Now engaged as a research chemist in the laboratory of Messrs. W. J. Bush & Co., Manufacturing Chemists, Hackney. Joint author of the following papers: (1) The Three Chlorobenzeneazosalicylic Acids (*Trans., J.C.S.*, 1896). (2) Ueber einige von Wroblewski's Bromparatoluidin (*Ber.*, 1898). (3) Die Einwirkung von α-Naphthylamin auf Bromtoluolazosalicylsäure (*Ber.*, [1898], 29). (4) Notiz über Azophenin (*Ber.*, 1898).

Edgar S. Barralet. de Bush.
J. T. Hewitt. O. J. Silberrad.
J. McCrae.

Welsford, Giles Hadden,

6, The Orchard, Blackheath, S.E.

Advanced Student of Chemistry. Now working in the Research Laboratory, at the Central Technical College, South Kensington, under Prof. H. E. Armstrong.

Henry E. Armstrong. T. Martin Lowry.
Gerald T. Moody. Edward W. Lewis.
William A. Davis. William Robertson.

Wilkinson, James Bates, M.D., C.M., D.P.H.,
Town Hall, and 6, Edward Street, Oldham.

Medical Officer of Health, Oldham County Borough. Superintendent to Oldham Sewage Works. Consulting M.O.H., Hunts. County Council. Two years in laboratory of F. E. Dembski, B.A., late Public Analyst, Stamford, St. Ives, and Huntingdon. Six months' Laboratory Practice, Owens College, Manchester. Director and Supt. of Chemical Laboratory at the Oldham Sewage Works for the past four years.

James Robt. Kaye. Gilbert J. Fowler.
Samuel Rideal. A. S. Wylie.
William. T. Burgess.

Wood, William Francis John,
Hazelhurst, Doncaster Road, Barnsley.

Chemist and Manager of Glass Works. B.Sc. London (1st division), now studying for 1st class honours B.Sc., view to D.Sc., London, under F. W. Richardson, F.I.C., of Bradford. 1st class Honours in S. and A. Practical Chemistry. Qualified Lecturer under County Council in Technical Instruction Classes in Chemistry, Physics, and Geology. Have lectured 3 years and at present am doing so under Barnsley Technical Instruction Committee in Electricity. Chemist and Manager of Borough Flint Glass Works, Barnsley. Three years student of F. W. Richardson, F.I.C., in his laboratories, Bradford, and my services were acknowledged in certain Papers. One on Sulphites, Sulphides, Sulphates, and Thiosulphates in *J.S.C.I.*

F. W. Richardson. *Thomas Fairley.*
G. W. Slatter. *Alfred H. Allen.*
H. E. Aykroyd. *B. A. Burrell.*

Worden, Edward Chancey,
Millburn, New Jersey, U.S.A.

Chemist. Graduate in Chemistry and in Pharmacy, University of Michigan. Chemist at the Government experiment station, Geneva, New York, 1896—97. Chemist for Boston Artificial Leather Co., Celluloid Zapon Co., and Messrs. Richards and Co., 12 E.18th Street, New York City and Millburn, N.J.

Albert B. Prescott. E. G. Love.
Clifford Richardson. R. A. Woodcock.
Peter A. Austen.

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Issued 30/4/03

PROCEEDINGS

OF THE

CHEMICAL SOCIETY.

Vol. 19. **No. 265.**

Wednesday, April 22nd, 1903. Professor W. A. Tilden, D.Sc., F.R.S., President, in the Chair.

Messrs. C. H. Lockitt, A. J. Webb, and A. H. Scholefield were formally admitted Fellows of the Society.

Certificates were read for the first time in favour of Messrs.:

Henry James Aubrey, The Cross, Worcester.
George Barger, B.A., B.Sc., 50, Guilford Street, W.C.
Charles Drake Bibby, 69, Queens Road, Twickenham.
H. J. W. Brennand, B.A., M.B., Ch.M., 203, Macquarie Street, Sydney.
John Christopher Mann, 9, Lambert Street, Hull.

A ballot for the election of Fellows was held and the following were subsequently declared duly elected:

Henry Guest Adshead.
William Lester St. John Alton.
Harford Montgomery Atkinson, B.Sc.
Robert Gordon Bibby.
George Neville Blackshaw, B.Sc.
Harry Thornton Calvert, B.Sc., Ph.D.
Ben Caudwell, B.A.
Thomas Divine, M.B., C.M.
Arthur William Eastwood, B.A.
John Percy Edgerton.
Alan Fletcher.
Henry Gough.
George Howsam.
Alfred Owen Jones.
James Stewart Kerr.
William Kirkby.
John George Collcutt Lock.
Arthur Ernest Pitt.
Harold Russell Pitt.
George Gilbert Pond, Ph.D.
Robert James Porter.
Frederick Robertson.
Archibald Louis Robinson, B.A.
Fitzroy Owen Jonathan Roose.
Ernest William Sawdon, B.Sc.
George Siddle.
Montague White Stevens.
Henry Edward Stevenson.
Giles Hadden Welsford.
James Bates Wilkinson, M.D., C.M.
William Francis John Wood, B.Sc.
Edward Chancey Worden.

Of the following papers, those marked * were read:—

*59. **"The velocity and mechanism of the reaction between potassium ferricyanide and potassium iodide in neutral aqueous solution." By F. G. Donnan and R. Le Rossignol.**

When potassium iodide and ferricyanide react in neutral aqueous solution, free iodine and potassium ferrocyanide are formed, a definite state of equilibrium being attained. If the free iodine is removed as fast as it is formed by means of sodium thiosulphate solution, the velocity of the direct reaction can be investigated by a method similar to that employed by Harcourt and Esson in their fundamental investigation on the speed of chemical reactions. It was found that the reaction proceeded according to the equation: $-dc/dt = kc_1^2c_2^3$, where c_1 = concentration of ferricyanogen ions, and c_2 = concentration of iodine ions.

The simplest interpretation of this equation is that the primary reaction involves *two* ferricyanogen ions and *three* iodine ions according to the equation: $2Fe(CN)_6 + 3I = 2Fe(CN)_6 + I_3$.

The exponents 2 and 3 of the velocity-equation were determined by separate variations of the ferricyanide and iodide concentrations.

The foregoing account of the mechanism of the reaction does not, however, explain all the experimental results, inasmuch as it gives no explanation of the peculiar fact that although the reaction appears to

be bimolecular with respect to the ferricyanogen ions (the concentration of the iodine ions remaining constant), nevertheless, the velocity-coefficient varied with the *initial* concentration of the potassium ferricyanide.

A theory which appears to be capable of giving a quantitative interpretation of all the observed results may be briefly summarised as follows:

1. The actual reaction is assumed to occur between free *ferric* ions and iodine ions according to the equation, $2Fe^{+++} + 3I^{-} = 2Fe^{++} + I_3^{-}$.

2. The ferric ions in question are assumed to result from an extremely small dissociation of the ferricyanogen ions into ferric and cyanogen ions.

3. The degrees of dissociation of the ferricyanogen and ferrocyanogen ions are assumed to be the same, or practically the same, in solutions containing the same number of equivalents.

Discussion.

Sir William Ramsay said that Mr. Le Rossignol's reaction was the first quinquemolecular reaction which, so far as he knew, had been investigated. It might appear almost incredible that free iron ions should exist in a solution of potassium ferricyanide, but it must be remembered that their concentration was so low that the most delicate tests for iron, namely, the ferrocyanide and ferricyanide reactions, failed to detect them. Mr. Le Rossignol had made an experiment in which he had electrolysed some potassium ferrocyanide, and he had obtained, after a long time, a deposition of metallic iron on the cathode; this, of course, might be due to a secondary reaction, but, so far as it went, it was in corroboration of the theory.

*60. "A microscopic method of determining molecular weights. A preliminary note." By G. Barger.

When two solutions of equal vapour tensions, produced by dissolving two substances in the same solvent, are left in a closed chamber, their volumes will not alter after the chamber has become saturated with the vapour of the solvent. If, however, the vapour tensions are unequal, the solvent will distil from the solution with the greater vapour tension into that with the less.

As the result of a suggestion by Prof. L. Errera, of the botanical laboratory of Brussels University, to the effect that this principle might be used for determining molecular weights, the author has elaborated a method, which apparently differs in certain essential features from those hitherto published, and is briefly as follows: A

standard solution of the substance, the molecular weight of which is to be determined, is compared with a number of standard solutions of a substance of known molecular weight.

Small quantities of the two solutions which are being compared are introduced into a capillary tube, where they form bi-concave, discoid drops, care being taken to use the solutions alternately, so that each drop of one solution is enclosed between two drops of the other. The capillary tube is then sealed at both ends, and the length of each drop is measured under the low power of a microscope with the aid of an eye-piece micrometer. After a few hours, or a day, the measurement is repeated, when, if the vapour tensions of the two solutions are unequal, the drops of one series are found to have increased in size, whilst the others have correspondingly diminished.

By using standard solutions of various strengths, an approximate value for the molecular weight is obtained, the limit of accuracy attained at present being about 10 per cent.

The method will undoubtedly be useful in deciding between multiples of an empirical formula in those cases where ebullioscopic methods are not available.

*61. "Note on the spectrum of pilocarpine nitrate." By W. N. Hartley.

In the current number of the *Transactions*, p. 452, there is a representation of the absorption curve of pilocarpine nitrate as determined by Professor Dobbie.

In the author's opinion, the curve is that characteristic of nitric acid, and is only indirectly associated with pilocarpine, certainly not belonging, or peculiar to, this alkaloid. On comparing the diagram with the curve common to nitric acid and potassium nitrate (*Trans.*, 1902, 81, 558), the similarity is easily recognised.

Although there are slight differences of detail in the absorption band, these are due to the recorded measurements not being made at exactly the same points or with solutions of the same concentration, and also in part to a slight modification of the nitric acid curve caused by the pilocarpine molecule.

Pilocarpine, if examined by itself or as a salt of any diactinic acid such as hydrochloric, acetic, or sulphuric acid, will be found to exhibit no absorption band.

This may be predicted both from the fact that pilocarpine nitrate is highly diactinic, and that stronger solutions than are usually employed were necessary in order to obtain clear indications of the absorption band, and also from the composition and structure of the

molecule, the evidence for which is adduced by Dr. Jowett. It is probable that pilocarpine and *iso*pilocarpine are not structurally different, although the manner in which they were examined does not justify the conclusion that their absorption curves are identical. It is not safe to draw inferences from solutions of nitrates of the alkaloids, particularly when the bases themselves exert but little absorption. In such cases, a more searching examination might disclose differences between the alkaloids. As the communication neither refers to the existence of the absorption band of nitric acid nor contains evidence of the absorption caused by pilocarpine and of *iso*pilocarpine alone or in combination with a highly diactinic acid, it might be supposed from a study of the paper that pilocarpine was characterised by an absorption band, but this is certainly not the case. It is evident that, as with caffeine, digitaline, and similar alkaloids (*Phil. Trans.*, 1885, 176, 471), the structure of pilocarpine does not confer on the base any peculiar absorptive power or selective absorption.

Discussion.

Dr. Dobbie said that the purpose of Professor Hartley's note was not to call in question the validity of the conclusion that pilocarpine and *iso*pilocarpine are probably isomerides, which had been based on the comparison of their nitrates, but to point out that no information as to the chemical structure of these bases could be derived from the fact that concentrated solutions of their nitrates showed a well-marked absorption band.

Such bands are usually, in the case of organic compounds, associated with the possession of a benzenoid, pyridine, or similar nucleus, but, inasmuch as nitric acid itself in concentrated solution gives a well-marked absorption band, the presence of a band in the nitrates examined afforded no evidence of the presence of such a nucleus in the alkaloids. The band of pilocarpine, and of *iso*pilocarpine nitrate, occupies the same position, and is very similar to, without being actually identical with, the band of nitric acid. Professor Hartley regards it as the band of nitric acid modified by the presence of the alkaloid. It is this modification of the band which is of importance in relation to the comparison between pilocarpine and *iso*pilocarpine, instituted in Dr. Jowett's paper. Since the modification is exactly the same in both cases, the conclusion that pilocarpine and *iso*pilocarpine must have the same chemical structure remains unaffected.

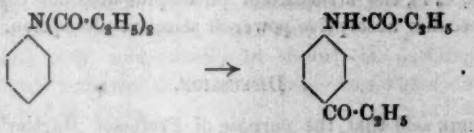
In this case, it was necessary to use concentrated solutions of the nitrates for the investigation, because it was found impossible to obtain satisfactory solutions of the free bases.

In the case of alkaloids of high molecular weight, such as berberine,

the absorption spectra of dilute solutions of the nitrate are practically the same as those of the chloride, and wholly different from the spectra of nitric acid. Professor Hartley's caution as to the employment of nitrates in the investigation of chemical structure by the spectroscopic method applies, therefore, more particularly to those highly diactinic substances, which, like pilocarpine, have comparatively low molecular weights.

62. "Isomeric change of dipropionanilide into propionyl-*p*-aminopropiophenone." By F. D. Chattaway.

Under the influence of various reagents, dipropionanilide, like diacetanilide and dibenzanilide, undergoes transformation into propionyl-*p*-aminopropiophenone:



Although the *o*-derivative is probably also formed in small amount, only the *p*-derivative can be isolated in quantity. As a catalytic agent, zinc chloride gives the best yield, but hydrogen chloride is also applicable, the transformation being most readily effected by heating propionanilide dissolved in an equivalent amount of propionic anhydride with about one-third its weight of dry powdered zinc chloride for 12 to 16 hours at 140—150°.

The product, after hydrolysis with alcoholic hydrogen chloride, is rendered alkaline and distilled in steam, the *p*-aminopropiophenone separating from the residual solution in reddish-yellow plates (yield = 50 per cent.). The base, which is obtained colourless by crystallisation from alcohol or chloroform, separates in flattened rhombs (m. p. 142°); its acetyl derivative forms colourless, hexagonal prisms (m. p. 175°). Kunckell (*Ber.*, 1900, **33**, 2641) describes these compounds as crystallising in yellow needles melting respectively at 140° and 161°.

p-*Aminopropiophenone sulphate*, $(C_2H_5\cdot CO\cdot C_6H_4\cdot NH_2)_2,H_2SO_4$, a sparingly soluble salt, forms anhydrous, colourless plates which become red and decompose at 223°; the *platinichloride*,

$$(C_2H_5\cdot CO\cdot C_6H_4\cdot NH_2)_2,H_2PtCl_6,$$

forms small, orange-coloured needles.

p-*Acetylchloroaminopropiophenone*, $C_2H_5\cdot CO\cdot C_6H_4\cdot NClAc$, colourless plates, m. p. 75°; p-*acetylbromoaminopropiophenone*, short, yellow prisms, m. p. 115°; p-*propionylaminopropiophenone*,

$$C_2H_5\cdot CO\cdot C_6H_4\cdot NH\cdot CO\cdot C_2H_5,$$

slender, colourless prisms, m. p. 153°; p-*propionylchloroaminopropiophenone*, $C_2H_5{\cdot}CO{\cdot}C_6H_4{\cdot}NCl{\cdot}CO{\cdot}C_2H_5$, colourless plates, m. p. 80°; p-*propionylbromoaminopropiophenone*, pale yellow, elongated plates, m. p. 120°; p-*benzoylaminopropiophenone*, $C_2H_5{\cdot}CO{\cdot}C_6H_4{\cdot}NH{\cdot}CO{\cdot}Ph$, thin, colourless, elongated plates, m. p. 190°; p-*benzoylchloroaminopropiophenone*, $C_2H_5{\cdot}CO{\cdot}C_6H_4{\cdot}NCl{\cdot}CO{\cdot}Ph$, colourless plates, m. p. 70°; p-*benzoylbromoaminopropiophenone*, bright yellow, rhombic plates, m. p. 111°.

When heated quickly, the nitrogen-halogen derivatives all undergo transformation at about 200—230° with much decomposition.

63. "Note on the formation of di- and hexa-methylammonio-cadmium chlorides." By W. R. Lang.

Dry methylamine and cadmium chloride react at −11°, but not at −80°, to form a white powder, corresponding with the formula $CdCl_2,6CH_3{\cdot}NH_2$. When heated to 100°, a stable substance is obtained having the composition $CdCl_2,2CH_3{\cdot}NH_2$, its decomposition is not complete at 300°.

ADDITIONS TO THE LIBRARY.

II. By Purchase.

Glaser, Christopher. The Compleat Chymist, or a New Treatise of Chymistry. Teaching by a short and easy method all its most necessary Preparations. Written in *French* by *Christopher Glaser*, Apothecary in Ordinary to the *French King*, and the *Duke of Orleans*. And from the fourth Edition, Revised and Augmented by the Author. *Now* faithfully *Englished* by a *Fellow* of the *Royal Society*. Illustrated with Copper Plates. London 1677.

III. Pamphlets.

Bull, Irving C. On the determination of lead in ores. (*From the School of Mines Quarterly*, 1902, 23, p. 348.)

Cutolo, Alessandro. Sulla ricerca delle sostanze coloranti artificiali negli alimenti in decomposizione. (*From the Bull. Soc. Nat. Napoli*, 15, 1901.)

—— Brodo di sangue (nuovo terreno di cultura). (*From the Bull. Soc. Nat. Napoli*, 16, 1902.)

Doane, Charles F., and Price, T. M. The influence of preservatives upon the food value of milk. (*Bull. No.* 86, *Maryland Agric. Exper. Station*, 1902.)

Thomsen, Julius. Fremgangsmaade, ved hvilken det hidtil hypotetiske stof Enkelt-svovlkulstof (CS.) med lethed kan dannes. 1902.

Van Slyke, L. L., and Hart, E. B. A study of some of the salts formed by casein and paracasein with acids; their relations to American cheddar cheese (*being Bull. No.* 214, *New York Agric. Exper. Station*, 1902).

Guthrie, Frederick Bickell. Analysis of Prickly Pear. 1900.

Colorado. The University of Colorado Studies. Vol. I. No 2. 1902.

Stieglitz, Julius. On the "Beckmann rearrangement." (University of Chicago Decennial Publications.) Chicago 1903.

RESEARCH FUND.

A meeting of the Research Fund Committee will be held in June. Applications for grants, to be made on forms which can be obtained from the Assistant Secretary, must be received on or before June 8th.

At the next meeting, on Thursday, May 7th, at 8 p.m., the following papers will be communicated:

"β-Bromonitrocamphor and β-bromocamphoryloxime. Influence of impurities in conditioning dynamic isomerism." By T. M. Lowry.

"The spontaneous decomposition of nitrocamphor." By T. M. Lowry.

"The active constituents of *Butea Frondosa*." By E. G. Hill.

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Issued 15/5/03

PROCEEDINGS

OF THE

CHEMICAL SOCIETY.

Vol. 19. No. 266.

Thursday, May 7th, 1903. Professor H. McLeod, F.R.S., Vice-President, in the Chair.

Messrs. F. H. Lees, R. Seligman, D. J. Williams, G. H. Welsford, and E. Gumersall were formally admitted Fellows of the Society.

Certificates were read for the first time in favour of Messrs.:

Ernest Bury, M.Sc., Brackley Coke Works, Little Hulton.
Thomas Campbell, Rosemount Villa, Queens Road, Bradford.
Albert James Carrier, B.Sc., 30, Kingwood Road, Bath,
Francis Gerald Harmer, Middle Class School, Leeds.
Frank William G. King, 15, Almond Road, Lower Tottenham, N.
Charles E. L. Livesey, St. Bede's Grammar School, Bradford.
Charles S. Purcell, 37, Acomb Street, Greenheys, Manchester.
Dennis Tyrrell, 182, King Street, Norwich.

The Chairman announced that the Council at its meeting that day had awarded the Longstaff Medal to Professor W. J. Pope, F.R.S., for his researches on the stereochemistry of compounds of elements other than carbon.

Of the following papers, those marked * were read:

*64. "The action of ammonia and organic bases on ethyl esters of olefinedicarboxylic and olefine-β-ketocarboxylic acids. Part II." By S. Ruhemann.

The olefine-β-ketocarboxylic esters may be obtained by the action of hydrogen chloride, not only on the dry mixture of an aldehyde and a β-ketonic ester, but also on their solutions in alcohol or benzene. In some cases, this method may be found more convenient than that recommended by Knoevenagel (*Ber.*, 1896, **29**, 172), according to which aldehydes react with β-ketonic esters in the presence of amines to yield either olefine-β-ketonic esters or saturated diketonic esters, the result depending on the temperature. It has now been found that piperidine, when added to a mixture of ethyl benzoylacetate and benzaldehyde, readily induces the formation, not of the saturated diketonic ester, but of the olefine-β-ketonic ester, ethyl benzylidenebenzoylacetate, $PhCO\cdot C(CO_2Et):CHPh$.

The author also showed that diethylamine effects, although much more slowly than piperidine, the formation of ethyl benzylideneacetoacetate, and that on adding the base to the alcoholic solution of benzaldehyde and ethyl benzoylacetate, the diketonic ester, $PhCH(CHBz\cdot CO_2Et)_2$, is obtained. This ester melts at 115—116°, the fused product solidifies on cooling, and then melts at 129—130°. These results differ from Knoevenagel's observation, according to which ethyl benzylidenebisbenzoylacetate melts at 95°. The difficulty with which ethyl benzoylacetate yields, with aromatic amines, diketonic esters is attributed to the stereochemical influence exercised by the phenyl group of the ester.

The esters of benzylidenebenzoylacetic, *m*-nitrobenzylideneacetoacetic, and *m*-nitrobenzylidenebenzoylacetic acids react with benzamidine in a manner similar to ethyl benzylideneacetoacetate (*Trans.*, 1903, **83**, 374); they lose either the acetyl group as ethyl acetate, or the benzoyl group as ethyl benzoate, and yield dihydrodiphenylpyrimidone, previously described (*loc. cit.*), or its nitro-derivative, $CH_2<\begin{matrix}CH(C_6H_4\cdot NO_2)\\ CO\text{——}N:CPh\end{matrix}>NH$ (m. p. 192—193°).

In the case of the action of benzamidine on ethyl benzylidenebenzoylacetate, it has been found that the benzoyl group is only partially removed, and that, besides dihydrodiphenylpyrimidone, its benzoyl derivative, $PhCO\cdot CH<\begin{matrix}CHPh\\ CO\cdot N:CPh\end{matrix}>NH$ (m. p. 241—242°), is produced.

Ethyl *m*-nitrobenzylidenemalonate reacts with benzamidine to form $NO_2 \cdot C_6H_4 \cdot CH<\begin{matrix}CH(CO_2Et)\cdot CO\\ NH\text{———}CPh\end{matrix}>N$ (m. p. 181—182°), a compound which, under the influence of ammonia, undergoes a transformation similar to that of ethyl dihydrodiphenylpyrimidonecarboxylate (*loc. cit.*), and yields dihydro-*m*-nitrophenyl-phenylpyrimidone (m. p. 192—193°).

***65. "Spontaneous decomposition of nitrocamphor." By T. M. Lowry.**

A quantity of nitrocamphor, prepared in 1898 and purified by recrystallising once from alcohol, was found to have undergone change, although a smaller specimen, which had been further purified and crystallised from benzene, was unaltered; 175 grams of the changed material gave 85 grams of crystalline nitrocamphor and 55 grams of a neutral substance sparingly soluble in spirit. This product, which melted at 256°, dissolved in acetone to the extent of 3·22 grams in 100 c.c. of solution at 13° and gave $[\alpha]_D = +33°$ in acetone. The substance is not readily acted on either by boiling hydrochloric acid or by alcoholic potash, but is oxidised to camphoric acid by heating with nitric acid at 100°. Molecular weight determinations in boiling benzene solution showed it to be a trimolecular compound, formed by the condensation of three molecules of nitrocamphor. One atom of nitrogen is eliminated in the condensation, probably as a result of the oxidation of 1 mol. of nitrocamphor to camphoric anhydride, and the analytical data agree with those required by the equation: $C_8H_{14}<\begin{matrix}CO\\ CO\end{matrix}>O + 2C_{10}H_{15}NO_2 = C_{30}H_{42}N_2O_5 + H_2O$. The substance has therefore the composition of a camphoric ester derived from nitrocamphor or one of its isomerides, and has been found to be identical with a *sesqui-camphorylhydroxylamine*,

$$C_8H_{14}\left[CO\cdot O\cdot N{:}C<\begin{matrix}C_8H_{14}\\ O\cdot CO\end{matrix}\right]_2,$$

prepared from camphoryl chloride and camphoryloxime.

***66. "β-Bromo-α′-nitrocamphor and β- and π-bromocamphoryloximes. The influence of impurities in conditioning isomeric change." By T. M. Lowry.**

β-Bromo-α′-nitrocamphor, $C_8H_{13}Br<\begin{matrix}CH\cdot NO_2\\ CO\end{matrix}$, prepared by reducing αβ-dibromo-α′-nitrocamphor with alcoholic potash, differs greatly from nitrocamphor, but closely resembles π-bromonitrocamphor.

The *pseudo*-form, $C_8H_{13}Br<\begin{matrix}C{:}NO_2H\\CO\end{matrix}$, separates in a pure state when a solution of the nitro-compound in benzene or ethyl acetate is slowly evaporated; it melts with slight decomposition at 132°, crystallises again on cooling, and remelts at or below 96°. The *normal* form was not isolated; a solution in methyl alcohol when slowly evaporated, gave a mixture of the two forms, and a solution in formic acid underwent isomeric change. A mixture of the two forms, obtained by crystallising from hot alcohol or acetic acid, softened at 100°, melted without decomposition at about 114°, and remelted sharply at 100°; the latter is therefore the temperature at which the solid *pseudo*-form is in stable equilibrium with the liquid mixture. The *potassium* salt of the *pseudo*-form crystallises from water in glistening needles with $2H_2O$ and is strongly dextrorotatory; the specific rotatory power of the nitro-compound in the salt is $[\alpha]_D = +103°$.

β-Bromocamphoryloxime, $C_8H_{13}Br<\begin{matrix}C{:}NOH\\>O\\CO\end{matrix}$, prepared by heating the nitro-compound with hydrochloric acid, separates from water in minute needles with $1H_2O$ and melts at 111°. The anhydrous oxime crystallises from benzene in glistening needles; a solution in chloroform saturated at 13° contains 2·20 grams in 100 c.c. and gives $[\alpha]_D = +10°$. The *acetyl* derivative crystallises from ethyl alcohol in minute flakes, melts at 112°, and has $[\alpha]_D = +3°$ in acetone. The *benzoyl* derivative crystallises from alcohol in needles, melts at 134°, and has $[\alpha]_D = +11°$ in acetone; unlike nitrocamphor, which gives the camphoryloxime benzoate, the potassium salt of *pseudo*-β-bromonitrocamphor could not be benzoylated by the Schotten-Baumann method.

π-Bromocamphoryloxime, isomeric with the preceding compound, was prepared synthetically from π-bromocamphoric anhydride and hydroxylamine, and is identical with the *iso*-π-bromonitrocamphor which Lapworth (*Trans.*, 1896, 69, 304) obtained by boiling π-bromonitrocamphor with hydrochloric acid; the acetyl derivative melts at 171° and the *benzoyl* derivative at 185°.

Freshly prepared solutions of β-bromo-α′-nitrocamphor exhibit the phenomenon of mutarotation. A solution in benzene of the *pseudo*-form is at first almost inactive (three specimens gave $[\alpha]_D = +2°$, 0°, and −4°), but in the course of 2 or 3 days the specific rotatory power becomes constant with $[\alpha]_D = -80°$.

The change of rotatory power is not spontaneous, but is conditioned by the presence of traces of impurity.

Three solutions in benzene of a mixture of normal and *pseudo*-β-bromonitrocamphor were prepared; part of each solution was at once transferred from the graduated flask to a tube and examined in the

polarimeter, and in each case a gradual change of rotatory power from $-72°$ to $-80°$ was observed during the first 24 hours; a few days later, the remainder of the solution in the flask was also transferred to a tube and examined; in one case only had a state of equilibrium been reached, whereas the other two solutions still exhibited their initial rotatory power, although an interval had elapsed three or four times as long as that normally required for the attainment of equilibrium.

Previous observations have shown that normal nitrocamphor does not change spontaneously on dissolution; the facts now recorded show, further, that even when both isomerides are present in solution, equilibrium between them is only established in presence of a catalytic agent, probably an alkali. A final proof is thus afforded that isomeric change, even when it consists merely in the transference of a mobile hydrogen atom, cannot be accomplished within the molecule, and can only be brought about by an intermolecular mechanism, involving at least three molecules and obeying the ordinary laws of chemical change. The phenomena are closely analogous to Baker's observations on the union of hydrogen and oxygen, and are directly opposed to Laar's hypothesis of "tautomerism."

Discussion.

Dr. Lapworth stated that the important observation that mutarotation did not occur in a solution containing a mixture of the two isomeric bromonitrocamphors found a parallel in the behaviour of camphorquinonehydrazone, for the mutarotation of this substance could apparently be arrested by the introduction of an acid at any stage, and therefore when both forms are present.

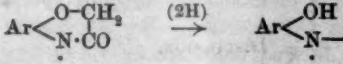
Although Dr. Lowry appeared to conclude that changes of this character were effected by the catalytic agents and would not occur in their absence, yet the usual assumption that the velocity simply becomes immeasurably small in the absence of catalysts seemed to meet the case as well as ever. In the absence of experimental methods for deciding between the two hypotheses, it was impossible to say which view was correct.

Dr. Forster suggested that, in order to avoid confusion arising from the notation of the new derivatives, the name β-bromonitrocamphor should be furnished with an affix indicating the position of the nitro-group, and asked whether Dr. Lowry had obtained fresh chemical evidence leading him to continue the representation of the *pseudo*-nitro-group by Hantzsch's original *iso*nitro-formula, which had been abandoned by chemists generally in favour of the nitronic representation.

In reply, Dr. LOWRY stated that the rotatory power of the labile solutions was probably not absolutely constant, as it was impossible, in practice, to prepare absolutely pure solutions; in some cases, an appreciable change could be detected, but in others the rotatory power was quite constant within the limits of experimental error. With regard to the notation of the nitro-derivatives, the nitro-group was probably not in the *a*- but in the stereoisomeric *a'*-position. The formula assigned to *pseudo*-nitrocamphor was in accordance with Perkin's observations on the magnetic rotatory power of the substance, which showed that the nitrogen was probably tervalent, and was also analogous to the formula generally adopted for the *iso*xímes.

***67. "The electrolytic reduction of pheno- and naphtho-morpholones." By F. H. Lees and F. Shedden.**

When phenomorpholone, *N*-methylphenomorpholone, and *N*-methyl-*β*-naphthomorpholone are electrolytically reduced in sulphuric acid, the first stage of the reduction involves for the most part a disruption of the morpholone ring according to the scheme:



In the case of phenomorpholone, the final products are acetyl-*o*-aminophenol, ethyl-*o*-aminophenol, and *isoacetyl-o-aminophenol*, $C_6H_4<^{OH}_{N=\!=C\cdot OH}{}^{CH_3}$. The third of these substances crystallises from alcohol in glistening leaflets, and melts at 190° with evolution of water vapour and the simultaneous formation of ethenyl-*o*-aminophenol; this behaviour differentiates it from acetyl-*o*-aminophenol, which melts at 205° and is only partially converted into the ethenyl-base at a temperature approaching 300°. The formation of *iso*acetyl-*o*-aminophenol is probably due to the existence in solution of two desmotropic forms of phenomorpholone, these isomerides each undergoing disruption during reduction in accordance with the foregoing scheme.

N-Methylphenomorpholone gives *N-acetylmethyl-o-aminophenol*, $C_6H_4(OH)\cdot NMeAc$, which separates from methylal in needles melting at 150°; *N-methylethyl-o-aminophenol*, $C_6H_4(OH)\cdot NMeEt$, the *hydrochloride* of which forms plates melting at 150°; and *N*-methylphenomorpholine, $C_6H_4<^{O\text{——}CH_2}_{NMe\cdot CH_2}$, which is identical with that obtained by Knorr in another way (*Ber.*, 1889, **22**, 2081).

β-Naphthomorpholone, $C_{10}H_6<^{(\beta)O\text{——}CH_2}_{(\alpha)NH\cdot CO}$ or $C_{10}H_6<^{(\beta)O\text{—}CH_2}_{(\alpha)N:C\cdot OH}$, was

prepared by the reduction of *α-nitro-β-naphthoxyacetic acid*, $C_{10}H_6(NO_2)\cdot OCH_2\cdot CO_2H$, the latter being obtained by two methods; (1) by nitrating β-naphthoxyacetic acid; (2) by condensing the potassium salts of α-nitro-β-naphthol and chloroacetic acid in aqueous solution. The nitro-acid separates from acetic acid in yellow prisms and melts at 188—189°; the morpholone obtained from the same solvent forms colourless needles and melts at 215—216°.

N-Methyl-β-naphthomorpholone, $C_{10}H_6\begin{smallmatrix}(\beta)O\text{——}CH_2\\(\alpha)NMe\cdot CO\end{smallmatrix}$, crystallises from alcohol in long, colourless needles melting at 84—85°. When reduced, it gives *N-methylethyl-α-amino-β-naphthol*, $C_{10}H_6(OH)\cdot NMeEt$, and *N-methyl-β-naphthomorpholine*, $C_{10}H_6\begin{smallmatrix}(\beta)O\text{——}CH_2\\(\alpha)NMe\cdot CH_2\end{smallmatrix}$. The former distils at 193° (corr.) under 40 mm. pressure and is a light yellow oil solidifying on cooling to needles which melt at 25—27°; the *sulphocamphylate*, $C_{12}H_{15}ON\cdot C_9H_{14}O_5S,H_2O$, separates from water in prismatic needles melting at 203—204°; the *hydriodide* crystallises from a mixture of acetone and ether in needles which melt at 183°; the *acetyl* derivative, $C_{12}H_{14}N\cdot OAc$, is a colourless oil boiling at 212—215° (corr.) under 40 mm. pressure. The morpholine distils at 220—222° under 40 mm. pressure as a viscid, light-yellow oil, having a blue fluorescence and a faintly basic odour; the *sulphocamphylate*, $C_{12}H_{19}ON\cdot C_9H_{14}O_5S,H_2O$, forms needles melting at 196°; the *methiodide*, $C_{12}H_{19}ON\cdot MeI$, separates in needles melting at 163—164° with evolution of methyl iodide.

Discussion.

Mr. Groves asked whether the authors had tried to reduce morphine electrolytically, and, if so, whether its morpholine ring underwent disruption in the manner observed with pheno- and naphtho-morpholones.

Mr. Lees, in reply, said that in connection with another investigation he had found that morphine is not changed when subjected to electrolytic reduction. Pheno- and naphtho-morpholones are aryloxy-compounds, whereas in morphine the ether-oxygen atom is attached to a partially reduced aromatic nucleus.

68. "The coloured constituents of Butea frondosa." By E. G. Hill.

The dried and fresh flowers of *Butea frondosa* are extensively used in India for the preparation of a somewhat fugitive yellow dye.

The aqueous extract of the flowers contains an easily decomposable

tannin which readily yields phlobaphen; this product, which separates from the solution as a dark, tarry precipitate on boiling with hydrochloric acid, is almost insoluble in warm water, but readily dissolves in alcohol or in aqueous alkalis; from the former solution, it is reprecipitated by water, and from the latter by acids. On evaporating the filtrate from the phlobaphen, an odour of charred sugar was noticed, this result suggesting the presence of a glucoside.

The freshly-prepared extract, when treated with lead acetate, yielded a yellow precipitate of a lead salt which, when suspended in water and decomposed by hydrogen sulphide, furnished a yellow solution, from which a yellow gum was obtained by evaporation. This product, when dissolved in water and extracted with ether, gave a light yellow ethereal solution, from which a semi-fibrous, yellow mass separated. This substance was soluble in hot water, alcohol, or acetic acid, and separated from the last-mentioned solvent in small, lemon-yellow crystals, which gave the reactions of fisetin (compare Perkin and Hummel, *J. Soc. Chem. Ind.*, 1895, 459, and Hummel and Cavallo, *Proc.*, 1894, 10, 11). At the time this work was carried out, the author had no access to the original papers of the foregoing authors.

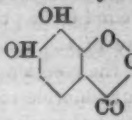
After separating the ethereal extract, the aqueous solution was hydrolysed by boiling with dilute hydrochloric acid; this reaction led to the precipitation of phlobaphen, several fractions of the product being collected during evaporation.

These fractions, which are probably different anhydrides of the same tannin, were all readily soluble in alcohol or aqueous alkalis, giving rise to deep reddish-brown solutions; they readily reacted with bromine, evolving hydrogen bromide and giving an amorphous powder lighter in colour than the original substance; this product yielded traces of methyl bromide on treatment with sodium hydroxide solution. Phloroglucinol and protocatechuic acid were obtained from the phlobaphen by fusion with potassium hydroxide.

69. "Butein. A preliminary notice." By (the late) J. J. Hummel and A. G. Perkin.

The announcement (this vol., p. 126) that a paper by E. G. Hill on "The Coloured Constituents of *Butea frondosa*" would be read at the next meeting of the Society, renders necessary the following note on the investigation of this dyestuff, which is now proceeding. *Butein*, the colouring matter of the flowers of *B. frondosa* (Hummel and Cavallo, *Proc.*, 1894, 10, 11), $C_{15}H_{10}O_5$, probably exists in two modifications: (*a*) colourless (C = 66·62; H = 4·32), and (*b*) orange-yellow (C = 66·31; H = 4·19), which, on fusion with alkali,

give resorcinol and protocatechuic acid. The *tribenzoyl* derivative, $C_{15}H_7O_5(C_7H_5O)_3$ (C = 74·02 ; H = 4·05), which forms colourless needles (m. p. 155—157°), and the *triacetyl* compound, $C_{15}H_7O_5(C_2H_3O)_3$ (C = 63·50 ; H = 4·05) have been studied. The dyeing properties of butein very closely resemble those of benzylideneanhydroglycogallol

(Friedländer and Rudt, *Ber.*, 1896, **29**, 879),  , the compound being probably a member of this or some closely allied series. When it is heated with sulphuric acid, a colouring matter is produced, the tinctorial properties of which are somewhat similar to those of alizarin.

70. "The relative affinities of polybasic acids." By H. M. Dawson.

The conceptions of avidity, as defined originally by Thomsen, and of affinity, as based on the theory of electrolytic dissociation, are not always identical.

For weak polybasic acids, the relative affinities are determined essentially at all ordinary concentrations by the primary dissociation of a single hydrogen ion, and direct values for the affinities as measured by their base combining powers will be obtained if the quantities of the two acids competing for a base are in the ratio of their molecular and not their equivalent weights.

In the case of strong polybasic acids, the affinity is a complex factor determined by more than one dissociation phenomenon, and a method of viewing such partition phenomena in the case of the stronger polybasic acids is brought forward.

71. "The chemical dynamics of the reactions between chlorine and benzene under the influence of different catalytic agents and of light." By A. Slator.

With a large excess of benzene, the reactions between this hydrocarbon and chlorine are practically limited to the two changes represented by the following equations: $C_6H_6 + Cl_2 = C_6H_5Cl + HCl$, $C_6H_6 + 3Cl_2 = C_6H_6Cl_6$, the relative amounts of the two chief products depending on the conditions of the experiment.

The velocity of these reactions has been measured under various conditions, especially under the influence of different catalytic agents. A chlorine solution of suitable concentration in dry benzene being

employed, the velocity of the reactions is measured by simultaneous titrations of chlorine and hydrogen chloride.

The reaction velocity without a catalytic agent is too small to be measured. Under the influence of iodine chloride, both the substitution and addition reactions take place. The velocity of disappearance of free chlorine is found to be proportional to the chlorine concentration and to the square of the iodine chloride concentration; the temperature coefficient of the reaction is very small. By investigating the reaction in carbon tetrachloride solution with varying quantities of benzene, it was shown that the velocity is proportional to the concentration of the hydrocarbon. It is found by estimating the hydrogen chloride that 70 per cent. of the chlorine takes part in the substitution reaction, whilst the remainder combines additively.

This ratio remains constant, even when the solvent is changed or the concentration of chlorine, iodine chloride, or benzene varied; it is also only slightly affected by temperature.

With tin tetrachloride and with ferric chloride as catalytic agents, the substitution reaction alone takes place. The accelerating effect due to a mixture of iodine chloride and tin tetrachloride is found to be approximately equal to the sum of that due to each agent acting separately.

Under the influence of light without catalytic agents, the addition reaction alone occurs; under conditions of equal illumination, the velocity of this change is found to be proportional to the square of the chlorine concentration.

72. "The diazo-reaction in the diphenyl series. Part I. On dianisidine and 3 : 3′-dichlorobenzidine." By J. C. Cain.

On heating aqueous solutions of the diazonium salts prepared from dianisidine and 3 : 3′-dichlorobenzidine, dark coloured, insoluble, infusible compounds are obtained instead of the expected dihydroxy-derivatives.

The products, which appear to be quinones, agree in composition with the formulæ $O{:}C_6H_3(OMe){:}C_6H_3(OMe){:}O$ or $\begin{matrix}C_6H_3(OMe)\cdot O\\ C_6H_3(OMe)\cdot O\end{matrix}\Big\rangle$ and $O\Big\langle\begin{matrix}C_6H_3Cl{:}C_6H_3Cl{:}O\\ C_6H_3Cl{:}C_6H_3Cl{:}O\end{matrix}$ or $O\Big\langle\begin{matrix}C_6H_3Cl\cdot C_6H_3Cl\cdot O\\ C_6H_3Cl\cdot C_6H_3Cl\cdot O\end{matrix}\Big\rangle$, the former in each case being the more probable one.

These substances are not affected by the usual reducing agents, but form additive compounds with hydriodic acid and acetic anhydride which are easily decomposed by alkalis, the original compounds being regenerated.

A strong aqueous solution of the diazonium salt from dichlorobenzidine, when heated with twice its volume of concentrated sulphuric acid, yields a very small quantity of 4 : 4′-dihydroxy-3 : 3′-dichlorodiphenyl (m. p. 124°); dianisidine does not give rise to a similar product.

RESEARCH FUND.

A meeting of the Research Fund Committee will be held in June. Applications for grants, to be made on forms which can be obtained from the Assistant Secretary, must be received on or before June 8th.

At the next ordinary Meeting, on **Wednesday, May 20th, at 5.30. p.m.**, the following papers will be communicated :

"Isomeric partially racemic salts containing quinquevalent nitrogen. Part XI. Derivatives of *dl*-methylhydrindamine and *dl-neo*-methylhydrindamine. Isomeric salts of the type $NR_1R_2H_3$." By G. Tattersall and F. S. Kipping.

"The conditions of decomposition of ammonium nitrite." By V. H. Veley.

"The action of liquefied ammonia on chromic chloride." By W. R. Lang and C. M. Carson.

"Note on the action of methylamine on chromic chloride." B W. R. Lang and E. H. Jolliffe.

"Cholesterol. A preliminary note." By R. H. Pickard and J. Yates.

R. CLAY AND SONS, LTD., BREAD ST. HILL, E.C., AND BUNGAY, SUFFOLK.

Issued 29/5/03

PROCEEDINGS

OF THE

CHEMICAL SOCIETY.

Vol. 19. No. 267.

Wednesday, May 20th, 1903. Professor W. A. TILDEN, D.Sc., F.R.S., President, in the Chair.

Mr. Francis Watts was formally admitted a Fellow of the Society.

Certificates were read for the first time in favour of Messrs.:

Colin Noel Bennett, 95, High Street, Camden Town, N.W.
William Hunter Gandy, Bradley Court, Mitcheldean, Gloucester.
John Howard Linday, Fenton Hall, Great Fenton, Stoke-on-Trent.
Arthur Moore, 83, Elgin Road, Seven Kings, Essex.
Thomas Rhind, M.R.C.S., 69, Gloucester Road, Regent's Park.
Charles J. Smith, "Sunnydale," Walton New Road, Stockton Heath.
Sidney H. Woolhouse, M.A., 2, Durham Road, Lower Edmonton, N.

THE DALTON CENTENARY.

The PRESIDENT stated that, in company with Sir Henry Roscoe and Dr. T. E. Thorpe, Past-Presidents, Professor Frankland, Vice-President, Dr. Scott, Senior Secretary, and Sir William Ramsay, Foreign Secretary,

delegates appointed by the Council, he had taken part in the celebration by the Literary and Philosophical Society of Manchester of the centenary of the enunciation of the Atomic Theory by John Dalton, and in the name of the Chemical Society had presented the following address:

THE CHEMICAL SOCIETY

TO THE

LITERARY AND PHILOSOPHICAL SOCIETY OF MANCHESTER.

GREETING.

Recognising the Atomic Theory as having been the foundation of scientific chemistry, the Chemical Society desires to be associated with the Literary and Philosophical Society of Manchester in celebrating the centenary of its enunciation by

JOHN DALTON.

The century which has elapsed since the recognition of the great generalisations which led to the establishment of the theory has afforded continuous proof of its importance throughout the whole domain of physical science, and especially of chemistry, every new development of which has served to consolidate its position.

The Chemical Society offers at the same time to the Literary and Philosophical Society, so much older than itself, an expression of hearty congratulations on having been the medium of the first publication of that theory to the world, and having for upwards of a century so honorably assisted in promoting scientific, literary, and philosophical inquiry, more especially in those early days before the time of Dalton, when the physical sciences were still unorganised and waiting for the firm and philosophical basis on which they now rest.

Signed on behalf of the Chemical Society,

WILLIAM A. TILDEN, *President.*
HORACE T. BROWN, *Treasurer.*
ALEXANDER SCOTT } *Secretaries.*
W. PALMER WYNNE }
WILLIAM RAMSAY, *Foreign Secretary.*

May 7th, 1903.

He reminded the Society that John Dalton was born in 1766, and was therefore a young man when, in 1803, he communicated to the

Literary and Philosophical Society a paper "On the Absorption of Gases by Water and other Liquids," to which is appended the first table of atomic weights. Dalton states in the preface to his "Chemical Philosophy," that a brief outline of his views and of the results of his experiments "was first publicly given in the ensuing winter in a course of lectures on natural philosophy at the Royal Institution in London." The first volume of the "Natural Philosophy," containing the well-known symbols of the atoms devised by Dalton, is dated 1808.

The President further announced that a bust of Dalton had been modelled with the aid of the Chantrey marble and various authentic portraits, one of which, a daguerreotype, is in the possession of the Society, and that the bust when finished would be offered to the Society, probably before the end of the session, by our Past-President, Dr. Thorpe.

CENTENARY OF THE BIRTH OF LIEBIG.

The PRESIDENT then stated that he had a further agreeable announcement to make.

The bust of Liebig which was placed on the table is a gift which the Society owes to the generosity of our Fellow, Dr. Messel.

It was probably not generally known that this year, and nearly at this time, is the hundredth anniversary of the birth of the famous German chemist. The day of the month is usually stated to be May 12th, and this is the date given in Hofmann's lecture, delivered before the Society in 1875, and is therefore probably correct. No time has therefore been lost in honouring this important event.

We in England should be among the first to acknowledge the debt which science and the world at large owes to Liebig. Sixty years ago, when at the height of his fame, he visited England, and although it is true that he found but little science in this country, he had many admirers here who assisted in promoting a knowledge of the principles of plant and animal physiology which had been so largely the product of his own researches. With the advance of time has come so much new knowledge that Liebig's teaching in connection with agriculture, physiology, and medicine seems now to be less influential than it was fifty years ago. We cannot, however, forget that his views represented at that time an immense stride in advance of the state of ignorance which previously prevailed. As chemists, we more especially recognise our indebtedness to Liebig not only as one of the chief founders of modern organic chemistry, but as having given us the system of practical instruction which, in principle, has

been adopted in all universities and chemical schools since his time. Whether any of the students who worked under his direction in the laboratory at Giessen still survive is uncertain, but those who went forth as teachers certainly transmitted to succeeding generations something of the spirit which animated all those who came under Liebig's influence.

Of the following papers, those marked * were read:

*73. "The conditions of decomposition of ammonium nitrite." By V. H. Veley.

The decomposition of ammonium nitrite into nitrogen and water proceeds according to the general law, $\log A/A - x = a\theta$, whether the reaction follows its normal course or is accelerated by the addition of another substance. The decomposition is either impeded or stopped by ammonia liberated in the solution by the addition of a metallic oxide, this effect being likewise produced by aliphatic, benzenoid, and pyridine amines, also by aromatic hydrazines, and to a less degree by oximes; it is temporarily accelerated by amides of the aliphatic series, but other amides are ineffective. Benzoic sulphinide ("saccharin"), the only imide tried, produces a considerable acceleration, but the reaction proceeds according to the general law.

It does not appear that solutions of ammonium nitrite, prepared from silver nitrite and ammonium chloride, become alkaline in the course of the decomposition. Incidentally it was shown that finely-divided barium sulphate, although producing no permanent effect when added to a solution of ammonium nitrite evolving nitrogen, nevertheless temporarily increased the rate of evolution of nitrogen, owing to some alteration in the amount of dissolved gas.

Discussion.

Dr. Divers thought from the results of the investigation by Dr. Haga and himself of the interaction of sulphurous and nitrous acids in presence of bases that it was free nitrous acid which, by its action on ammonium nitrite or ammonia, gave rise to the production of nitrogen.

Dr. Lapworth said that Dr. Veley's observations recalled the work of Hantzsch and Schümann, who had shown (*Ber.*, 1899, **32**, 1691) that the velocity with which diazotisation of aromatic amines takes place is accelerated by an excess of acid. This change is not, as

usually represented, a decomposition of the nitrite of the base, but is the effect of free nitrous acid on the substituted ammonium salt, or, in other words, the result of the interaction of the substituted ammonium ions with un-ionised nitrous acid.

Dr. VELEY agreed with Dr. Divers that the initial change in the decomposition of ammonium nitrite was the resolution of the salt into its constituent base and acid, as is also the case with ammonium nitrate. The nitrogen or nitrous oxide resulted from a subsequent interaction of the liberated ammonia with the nitrous or nitric acid respectively.

***74. "Freezing point curves for some binary mixtures of organic substances, chiefly phenols and amines." By J. C. Philip.**

When the initial freezing points of a series of mixtures of two subtances are determined and these temperatures are plotted against concentration, a freezing point curve is obtained which, in the simplest case, consists of two branches, starting from the freezing points of the constituents and cutting each other at a eutectic point. If, however, the two substances can unite to form a compound, the two branches are cut by another intermediate curve, which may sometimes have a summit.

Examples of the latter type of curve with an intermediate branch have been found by the author for the system phenol—urea, where the summit occurs with a mixture containing 33 molecular per cent. of urea, and for the systems *p*-cresol—aniline, phenol—α-naphthylamine, phenol—*p*-toluidine, α-naphthol—*p*-toluidine, phenol—picric acid, in all of which cases the summit occurs when the compounds are in molecular proportion.

According to Roozeboom's theory, the summit of the intermediate branch is reached with a mixture corresponding in composition with the formula of the compound, and crystals of this compound separate from all mixtures falling within the limits of the intermediate branch. This view has been confirmed in the above cases by analysis of the crystals which separated when solidification began.

In the freezing point curve for phenol—urea, the intermediate branch is cut abruptly at the summit by another branch ending, apparently, at the freezing point of urea. Perhaps the most interesting freezing point curve obtained was that for phenol—*p*-toluidine, inasmuch as the compound formed by these two substances exists in two modifications with an intermediate branch on the freezing point curve corresponding with each variety. The compound of phenol and α-naphthylamine crystallises so slowly that it was found possible to realise considerable

portions of the ordinary branches of the freezing point curve underneath the intermediate branch and below the eutectic temperatures.

The compounds of *p*-cresol and aniline (plates; f. p. 21°), phenol and *p*-toluidine (plates; f. p. 29°), α-naphthol and *p*-toluidine (needles; f. p. 53·5°), phenol and picric acid (bright yellow needles; f. p. 83°) have not been previously described.

Discussion.

Dr. Lowry referred to the melting point curves for mixtures of water with succinic and phthalic anhydrides recently plotted by van der Stadt (*Zeit. physikal. Chem.*, 1902, **41**, 353). In these cases, the "compound" (that is, the acid) is much more stable and less fusible than its components, so that these only separate from the fused product when this consists of almost pure water or pure anhydride; the central portion of the curve thus extends from about 0 up to 96 or 98 molecular per cent. of anhydride. Moreover, the extent to which the "compound" dissociates on fusion can be gauged from the form of the central portion of the curve; if there were no dissociation, this would consist of two intersecting lines, but if there is much dissociation the pointed crest becomes replaced by a rounded summit, and in extreme cases may even be reduced to a broad, flattened convexity.

Mr. Crompton inquired whether the author had ascertained to what extent his results were in agreement with the Schroeder-Le Chatelier formula.

Dr. Desch referred to the interest which the author's results presented in connection with the study of metallic alloys, and inquired whether, in the cases examined, the descending and ascending branches of the freezing point curve were represented by straight lines. In the majority of alloys, these branches are more or less curved, indicating the formation of solid solutions, even if only to a limited extent.

Dr. Philip, in reply, said that the freezing point curve for the system, acid anhydride—water, which had an intermediate summit at a temperature far above the freezing points of the constituents, resembled those of the systems, mercury—sodium and α-naphthol—picric acid, studied by Kurnakoff and Kuriloff respectively.

He had not attempted to apply the Schroeder-Le Chatelier formula to his results, as the subject had been treated entirely from the experimental point of view.

The branches of the freezing point curve, starting from the freezing points of the components, although sometimes very nearly rectilinear, were, in the majority of cases, slightly concave to the concentration axis.

75. "Isomeric partially racemic salts containing quinquevalent nitrogen. Part XI. Derivatives of *dl*-methylhydrindamine and *dl-neo*-methylhydrindamine. Isomeric salts of the type $NR_1R_2H_2$." By G. Tattersall and F. S. Kipping.

The *β*-methyl-*α*-hydrindamine, obtained by reducing methylhydrindoxime, has been separated into the two externally compensated bases of which it is composed by the use of *d*-bromocamphorsulphonic acid, which forms with each of the *dl*-bases a partially racemic salt. The externally compensated base, which is present in the larger quantity, is called *methylhydrindamine*, the other being termed neo-*methylhydrindamine*.

Methylhydrindamine bromocamphorsulphonate,

$$C_{10}H_{13}N,C_{10}H_{14}OBr\cdot SO_3H,H_2O,$$

crystallises from dilute alcohol in hydrated, rhomboidal prisms, and, when dehydrated, melts at 160—165°. In dilute aqueous solution, this salt has a specific rotation $[\alpha]_D = +51{\cdot}5°$, and a molecular rotation $[M]_D = +235{\cdot}5°$. These values are abnormal, because, since the salt contains *dl*-base, its molecular rotation should be that of the bromocamphorsulphonic acid, namely, $[M]_D = +270°$.

The *benzoyl* derivative of methylhydrindamine melts at 151°; the *hydrochloride*, *sulphate*, and *picrate* are also described.

neo-*Methylhydrindamine bromocamphorsulphonate*,

$$C_{10}H_{13}N,C_{10}H_{14}OBr\cdot SO_3H,$$

crystallises from alcohol in large, anhydrous, transparent prisms melting at 194°; its specific rotation in dilute aqueous solution is $[\alpha]_D = +58{\cdot}9°$, whence $[M]_D = +269{\cdot}5°$. This value is normal on the assumption that the salt is partially racemic, and this was proved to be the case.

The *benzoyl* derivative of *neo*-methylhydrindamine melts at 169°. The *hydrochloride*, *sulphate*, and *picrate* of the neo-base are also described.

dl-Methylhydrindamine bromocamphorsulphonate is not resolved by ordinary fractional crystallisation, but when treated with a mixture of warm alcohol and ethyl acetate a precipitate of the salt of the *l*-base is obtained, the salt of the *d*-base remaining in solution.

l-*Methylhydrindamine bromocamphorsulphonate* separates from water in long, anhydrous needles, the original melting point of which is 230°; its specific rotation in dilute aqueous solution is $[\alpha]_D = +45{\cdot}7°$, and molecular rotation $[M]_D = +209{\cdot}4°$. The free base is lævorotatory in dilute aqueous solution; its *hydrochloride*, which crystallises from water in needles or plates, has $[M]_D = +56°$.

d-*Methylhydrindamine bromocamphorsulphonate* is indistinguishable

in appearance from the salt of the *l*-base; it has an original melting point of 249°; its specific rotation is $[\alpha]_D = +71°$, and molecular rotation $[M]_D = +326°$. The free base is dextrorotatory in aqueous alcoholic solution.

The formation of isomeric partially racemic salts of the same type as those formed from hydrindamine and *d*-bromocamphorsulphonic acid having been expected, and such isomerides not having been found in the original mixture of salts, the question of their existence was solved by decomposing each of the pure partially racemic salts and regenerating each separately from its components. Crystallisation of the products failed to reveal the presence of any isomerides, so that it is concluded that isomeric partially racemic *a*- and *β*-salts of methylhydrindamine and *neo*-methylhydrindamine do not exist.

Isomeric Salts of the Type $NR_1R_2H_2$.—On fractionally crystallising *l*-methylhydrindamine bromocamphorsulphonate, the melting point of the first fraction after about 20 crystallisations rose to 236°, thus indicating that the original salt is a mixture. The pure salt (m. p. 236°) was then decomposed and regenerated from the same base and the same acid; fractional crystallisation of this product gave deposits with melting points gradually falling from 236° to about 224°. The first and last fractions were found to differ also in specific rotation, the first fraction (*al*) having $[\alpha]_D = +47°$, $[M]_D = +216°$, whilst the last gave $[\alpha]_D = +41°$, $[M]_D = +188°$. The existence of isomeric salts derived from *l*-methylhydrindamine and *d*-bromocamphorsulphonic acid is thus proved.

The isomeric salt melting at 236° is called the *al*-salt; the second isomeride, which is named the *βl*-salt, could not be obtained in a pure condition.

The *d*-methylhydrindamine bromocamphorsulphonate obtained by the resolution of the partially racemic salt was treated in the same way as the salt of the *l*-base, and regenerated from its component acid and base; the product was fractionally crystallised. The specific rotations in dilute aqueous solution and the melting points of the first and last fractions were found to be as follows:

First fraction (*ad*). $[\alpha]_D = +73°$, $[M]_D = +334°$; m. p. 262°.
Last fraction ..... $[\alpha]_D = +67°$, $[M]_D = +307°$; m. p. about 240°.

Here, again, the existence of isomerides, distinguished as the *ad*- and *βd*-salts, is established, but the former only was obtained in a pure condition.

The original *l*- and *d*-components are, therefore, mixtures and consist of *al*- and *βl*-, and *ad*- and *βd*-salts respectively. If equal quantities of each are mixed before systematic crystallisation, the original partially racemic salt is obtained. If, however, equal weights of the

al- and *ad*-salts are mixed, a partially racemic salt, different from the original one, is obtained:

	M. p.	Crystalline form.	$[\alpha]_D$ in water.
Original partially racemic salt	160—165°	Rhomboidal prisms.	+51°.
Synthetical partially racemic salt...	206°	Rectangular prisms.	+60°.

The original partially racemic salt consists of the four components, namely, *al*-, *βl*-, *ad*-, and *βd*-salts, and corresponds with the partially racemic *β*-salt obtained from *dl*-hydrindamine and *d*-bromocamphorsulphonic acid.

76. "The action of liquefied ammonia on chromic chloride." By W. R. Lang and C. M. Carson.

When liquefied ammonia acts on violet chromic chloride, a salmon-coloured powder is produced, from which water extracts two distinct compounds, which are easily crystallisable *in vacuo* and correspond in composition with the formulæ $Cr_2Cl_6,12NH_3,2H_2O$ and $Cr_2Cl_6,10NH_3$. The former substance is yellow, whilst the latter has the colour of cobalt nitrate. The salmon-coloured powder, when kept at 15°, yields both yellow and red crystals, but if heated to 110° it gives the red substance only. These compounds are completely decomposed at 180°.

77. "Note on the action of methylamine on chromic chloride." By W. R. Lang and E. H. Jolliffe.

Methylamine acting on violet chromic chloride produces a pink powder very readily soluble in water, from which it can be crystallised with difficulty owing to the rapidity with which chromium hydroxide separates out. The composition of the crystals corresponds with the formula $Cr_2Cl_6,10CH_3{\cdot}NH_2$. The pink compound, when heated at 100°, yields a substance containing 8 mols. of ammonia; complete decomposition into chromic oxide occurs at 120°.

78. "Cholesterol. Preliminary note." By R. H. Pickard and J. Yates.

Owing to the recent publication of the *Habilitationschrift* (Freiburg) of A. Windaus bearing the above title, the authors wished to state that for over two years they have been investigating the constitution of cholesterol obtained from gallstones. The effects of nitric acid, fused potas-ium hydroxide, potassium chlorate and hydrochloric acid,

and alkaline permanganate solution on cholesterol have been studied in turn. The results hitherto obtained show that the cholesterol is composed of a very stable, complex nucleus joined to a normal chain of some nineteen carbon atoms, inasmuch as arachidic acid, $C_{20}H_{40}O_2$, is one of the products of its oxidation. The hydrocarbons obtained when cholesterol is treated with dehydrating agents and the action of alkalis on the halogen derivatives of cholesterol are also being investigated.

79. "Hydrogen cyanide in fodder-plants." By J. C. Brünnich.

After the important discovery, by Messrs. Dunstan and Henry, of a glucoside "Dhurrin" (*Proc. Roy. Soc.*, 1902, **70**, 153) in the young plants of sorghum, which, on decomposition in presence of water, yields hydrogen cyanide, the author, on behalf of the Queensland Department of Agriculture, carried out a series of experiments in order to ascertain at what stages and conditions of growth the fodder-plants belonging to the sorghum family are most dangerous. Two varieties of sorghum, and also a variety of maize, were grown on unmanured and heavily manured plots and analysed at various stages. The results show that sorghums should never be used as fodder in very young and immature stages of growth.

80. "Sulphocampholenecarboxylic acid." By A. W. Harvey and A. Lapworth.

When sulphocampholenecarboxylic acid (*Proc.*, 1902, **18**, 142) is oxidised with potassium permanganate, no oxalic acid is formed, and the product consists almost entirely of acids which cannot be removed from a strongly acidified aqueous solution by ether, ethyl acetate, or acetone, and is therefore probably a mixture of sulphonic acids. A minute quantity of a volatile fatty acid, perhaps acetic acid, was detected. When the oxidation product is carefully fused with potassium hydroxide, it yields a mixture of carboxylic acids, the main constituent being identified as *aa*-dimethylglutaric acid.

The *methyl* ester, $CO_2Me{\cdot}C_9H_{14}Br{\cdot}SO_2{\cdot}O$ (m. p. 192—193°), and the *ethyl* ester, $CO_2Et{\cdot}C_9H_{14}Br{\cdot}SO_2{\cdot}O$ (m. p. 101—102°), are very easily obtained from the sultonecarboxylic acid (*loc. cit.*) by Fischer's method. The carboxyl group is therefore attached to a hydrogenated carbon atom.

The above observations indicate (1) that in the formation of sulphocampholenecarboxylic acid from *a*-bromocamphor, scission has occurred between the carboxyl group and the trimethyl*cyclo*pentane nucleus,

(2) that the acid does not contain the group $:C:CH\cdot CO_2H$, but probably $:C\cdot CH_2\cdot CO_2H$, (3) that it is most probably related to β- and not to α-campholenic acid in spite of its optical activity, which is perhaps due to the presence of the sulphonic group.

81. "Optically active esters of β-ketonic and β-aldehydic acids. Part III. Azo-derivatives of menthyl acetoacetate." By A. Lapworth.

Menthyl phenylazoacetoacetate, $C_6H_5\cdot N_2\cdot CHAc\cdot CO_2\cdot C_{10}H_{19}$, from menthyl acetoacetate and phenyldiazonium sulphate in presence of sodium acetate, forms large, transparent crystals melting at 76—77°. In a 1½ per cent. solution in benzene, it has initially $[\alpha]_D = -21{\cdot}62°$, and this rises after some days to a constant value, $[\alpha]_D = -52{\cdot}52°$. The corresponding p-*tolylazo*-compound, $C_6H_4Me\cdot N_2\cdot CHAc\cdot CO_2\cdot C_{10}H_{19}$, melts at 86—87°, and in benzene has $[\alpha]_D = -11{\cdot}86°$ changing to $-61{\cdot}56°$; with phenylhydrazine, it yields p-*methylphenyl*-4-*azo*-1-*phenyl*-3-*methyl*-5-*pyrazolone*, $\begin{matrix} CMe{:}N\text{————}NPh \\ | \qquad\qquad | \\ CH(N_2\cdot C_6H_4Me)\cdot CO \end{matrix}$, which forms yellow or orange needles melting at 136—137°.

Menthyl p-*bromophenylazoacetoacetate*, $C_6H_4Br\cdot N_2\cdot CHAc\cdot CO_2\cdot C_{10}H_{19}$, melts at 119—121°, and, in benzene solution, has $[\alpha]_D = -12{\cdot}84°$ changing to $-46{\cdot}88°$; with phenylhydrazine, it gives rise to 4-*bromophenylazo*-1-*phenyl*-3-*methyl*-5-*pyrazolone*, $\begin{matrix} CMe{:}N\text{————}NPh \\ | \qquad\qquad | \\ CH(N_2\cdot C_6H_4Br)\cdot CO \end{matrix}$, which melts at 152—153°.

Menthyl p-*chlorophenylazoacetoacetate*, $C_6H_4Cl\cdot N_2\cdot CHAc\cdot CO_2\cdot C_{10}H_{19}$, melts at 103—105°, and in benzene has $[\alpha]_D = -15{\cdot}43°$ changing to $-55{\cdot}79°$; with phenylhydrazine, it gives 4-p-*chlorophenylazo*-1-*phenyl*-3-*methyl*-5-*pyrazolone* melting at 141—142°.

The mutarotation of the above compounds is accelerated by traces of bases or acids. By the action of diazo-oxides on the esters, formazyl compounds are formed. The following have been isolated, but the colour of their solutions is too intense to admit of the determination of their rotatory power.

Menthyl pp′-*dimethylphenylformazylcarboxylate*,

$$C_6H_4Me\cdot NH\cdot N{:}C(N_2C_6H_4Me)\cdot CO_2\cdot C_{10}H_{19},$$

forms dark red crystals with a blue reflex and melts at 134—136°; *menthyl* p-*bromophenyl*-p′-*methylphenylformazylcarboxylate* melts at 149—151°; *menthyl* p-*chlorophenyl*-p′-*methylphenylformazylcarboxylate* melts at 145—147°.

The mutarotation of the azo-derivatives of menthyl acetoacetate is due to *iso*dynamic change in virtue of the lability of the α-hydrogen

atom, and when this hydrogen atom is replaced by bromine the specific rotation becomes invariable. The α-bromo-derivatives, which represent a new class of azo-compounds, were made (1) by direct bromination of the above esters, (2) by the interaction of a diazo-oxide and menthyl α-bromoacetoacetate.

Menthyl phenylazo-α-bromoacetoacetate, $C_6H_5 \cdot N_2 \cdot CBrAc \cdot CO_2 \cdot C_{10}H_{19}$, forms large, yellow crystals melting at 133—134°; it has $[\alpha]_D = -82{\cdot}45°$ in benzene. The corresponding p-*tolylazo*-compound, $C_6H_4Me \cdot N_2 \cdot CBrAc \cdot CO_2 \cdot C_{10}H_{19}$, melts at 155—156° and has $[\alpha]_D = -85{\cdot}95°$. The p-*bromophenylazo*-compound,

$$C_6H_4Br \cdot N_2 \cdot CBrAc \cdot CO_2 \cdot C_{10}H_{19},$$

melts at 155° and has $[\alpha]_D = -73{\cdot}45°$; the p-*chlorophenylazo*-compound melts at 147—148°; it has $[\alpha]_D = -67{\cdot}61°$. The crystals of these four compounds exhibit anomalous dispersion of the optic axes.

The following note has been received since the meeting:

82. "The chemical reactions involved in the rusting of iron." By W. R. Dunstan.

In a lecture delivered before the Royal Artillery Institution at Woolwich, the substance of which was published in the *Proceedings* of that Institution (Vol. 26, 1899, No. 5) and also in *Engineering*, June 1, 1900, the author gave a general account of the results of an investigation of the chemical process of rusting. This investigation, which was conducted with the cooperation of Dr. Jowett, was afterwards continued, and with the assistance of Mr. E. Goulding extended, especially to the atmospheric corrosion of iron and steel, and a further account of the results obtained was published in the Report (1900) of the Steel Rails Committee of the Board of Trade, of which the author was a member. Since then, the inquiry has been further extended, especially with reference to the atmospheric corrosion of pairs of metals and to the elucidation of the general process. Various circumstances have, however, delayed the completion of the work, and the present summary of the results is published pending the preparation of a fuller account of the investigation.

It has been proved that whilst both liquid water and oxygen are necessary for the formation of rust, the presence of carbonic acid is not essential, although it may accelerate the action. The well-known effect of alkalis and alkaline salts in preventing the oxidation of iron has been hitherto attributed to the withdrawal of the carbonic acid. It has been found, however, that the phenomenon is not due to this

cause, but to the establishment of conditions in which the production of hydrogen peroxide is inhibited.

When highly purified iron, containing mere traces of impurity, is left in contact with dry gases (oxygen, carbon dioxide, mixtures of oxygen and carbon dioxide), rusting does not take place. In the presence of the same gases and water vapour, no rusting occurs so long as a constant temperature (34° in the actual experiments) is maintained, but if the temperature is allowed to fluctuate, liquid water condenses on the surface of the iron and rust is produced. It is thus shown that pure iron is not oxidised in presence of gases and water-vapour only, but that the presence of liquid water is necessary for rusting to take place.

In another series of experiments, pieces of iron were left in contact with water saturated with a particular gas and with an atmosphere of the same gas above the solution. When hydrogen, carbon dioxide, or nitrogen which had been carefully freed from oxygen was employed, rusting did not occur, but if oxygen or a mixture of oxygen and carbon dioxide was used, oxidation took place. From these results, it is evident that for the formation of rust both oxygen and liquid water are required. In the experiments in which a mixture of oxygen and carbon dioxide was used, the results observed indicated that in this case a secondary action proceeds simultaneously.

In order to investigate the influence of solutions of various salts on the production of rust, small pieces of highly purified sheet iron were enclosed with the different solutions in sealed glass tubes, the space above the solution in each case being filled with pure oxygen. The following substances were found to prevent to a greater or less extent the formation of rust: sodium carbonate, ammonium carbonate, borax, disodium hydrogen phosphate, calcium hydroxide, ammonia, potassium dichromate, potassium ferrocyanide, chromic acid, sodium nitrite, and potassium carbonate. Rusting occurred in the presence of the following compounds: sodium chloride, potassium chlorate, ferrous sulphate, potassium ferricyanide, potassium nitrate, and sodium sulphate. The reagents which prevent the rusting of iron are those in presence of which decomposition of hydrogen peroxide takes place and which are consequently inimical to its formation. There can be little doubt, therefore, that hydrogen peroxide plays an important part in the chemical process of rusting. By the direct action of hydrogen peroxide on metallic iron, a red basic ferric hydroxide, identical with ordinary rust, is rapidly produced, and it is found that in general those metals rust in air which are oxidised by hydrogen peroxide, whilst those metals which are not oxidised by hydrogen peroxide do not rust in air. Iron, zinc, and lead are examples of the first class, and the rusting of all these metals is stopped by contact with substances which prevent

the formation of hydrogen peroxide. Copper, silver, and nickel are examples of the second class; these metals do not rust in air and are not oxidised by hydrogen peroxide.

The analysis of a number of specimens of iron rust has shown that its composition may be represented by the formula $Fe_2O_2(OH)_2$.

The chemical reactions concerned in the process of rusting may therefore be represented by the following equations: $Fe + O_2 + H_2O = FeO + H_2O_2$. $2FeO + H_2O_2 = Fe_2O_2(OH)_2$.

The presence of water in the liquid state is essential alike for the occurrence of rusting and for the formation of hydrogen peroxide.

In the case of certain metals, notably that of zinc, hydrogen peroxide can be detected during the process of rusting. It has not been possible, however, to detect with certainty the presence of hydrogen peroxide during the rusting of iron. This may be due to the fact, previously mentioned, that iron is very rapidly oxidised by hydrogen peroxide with formation of rust, so that under ordinary conditions the hydrogen peroxide is quickly destroyed.

The influence of certain other reactions on the process of rusting has been studied and may be summarised as follows:

(I) The direct decomposition of water by metallic iron with liberation of hydrogen can take place only at a relatively high temperature and is not affected by the presence of alkaline salts, such as sodium carbonate.

(II) The action of aqueous carbonic acid on iron in the absence of oxygen results in the liberation of hydrogen and formation of ferrous carbonate or bicarbonate. If oxygen is present, the ferrous salt subsequently undergoes oxidation, the rust obtained in this case containing a varying amount of carbonate.

(III) Electrolytic action occurs when the iron is impure or when another metal is present. The electropositive metal suffers oxidation and hydrogen gas is evolved. This action is not prevented by the presence of sodium carbonate.

ADDITIONS TO THE LIBRARY.

I. *Donations.*

Hartley, H. B. Polymorphism. pp. 29. From the Author.

Frankland. Autobiographical sketches from the life of Sir Edward Frankland, K.C.B., F.R.S. pp. 480.

From Mrs. West and Mrs. Colenso.

II. *By Purchase.*

Georgievics, G. von. Chemistry of dyestuffs, translated from the second German edition by Charles Salter. pp. 402. London 1903.

Klöcker, Alb. Fermentation organisms. A laboratory hand-book. Translated from the German by G. E. Allan and J. H. Millar, and revised by the author. pp. 392. ill. London 1903.

International Catalogue of Scientific Literature. First Annual Issue. C. Physics, Part II; G. Mineralogy, including petrology and crystallography, 2 vols. London 1903.

Richter, V. von. Chemie der Kohlenstoffverbindungen oder organische Chemie. Zehnte Auflage. Bearbeitet von R. Anschutz in Gemeinschaft mit G. Schroeter. Vol. I, *Die Chemie der Fettkorper.* pp. 746. ill. Bonn 1903.

Wolfrum, A. Chemisches Praktikum. Teil II. Präparative und fabrikatorische Übungen. pp. 575. ill. Mit einem Atlas. Leipzig 1903.

—— Die Grundzüge der chemischen Didaktik. Eine Studie über das Studium Chemie und den Laboratoriumsunterricht. pp. 147. Leipzig 1903.

III. *Pamphlets.*

Betti, Mario. Benaftossazine e composti affini contenenti radicali aldeidici e chetonici misti (*From the Gazz. Chim. Ital.*, 33, pt. I, 1903.)

—— Sulla funzione delle basi β-naftol-aldaminiche. (*From the Gazz. Chim. Ital.*, 33, pt. I, 1903.)

—— Reazione generale di condensazione fra β-naftolo, aldeidi e amine. (*From the Gazz. Chim. Ital.*, 33, pt. I, 1903.)

Clemm, W. N. Die Gallensteinkrankheit, ihre Häufigkeit, ihre Entstehung, Verhütung und Heilung durch innere Behandlung. Berlin 1903.

Garland. La industria del petróleo en el Perú en 1901. (*Being Boletin del Cuerpo de Ingenieros de Minas del Peru No.* 2.)

Hall, A. D. The continuous growth of mangels for twenty-seven years on the same land, Barn Field, Rothamsted. (*From the Journ. of the Royal Agricultural Society of England*, vol. 63, 1902.)

Langworthy, C. F. The functions and uses of foods. (*Being U.S. Dept. of Agric. Office of Experiment Stations Circular* 46.)

National Physical Laboratory. Reports for years 1901–2.

RESEARCH FUND.

A meeting of the Research Fund Committee will be held in June. Applications for grants, to be made on forms which can be obtained from the Assistant Secretary, must be received on or before June 8th.

At the next ordinary Meeting, on **Thursday, June 4th, 1903, at 8 p.m.**, the following papers will be communicated:

"Imino-ethers corresponding to ortho-substituted benzenoid amines." By G. D. Lander and F. T. Jewson.

"Formation of an anhydride of camphoryloxime." By T. M. Lowry.

"The mutarotation of glucose as influenced by acids, bases, and salts." By T. M. Lowry.

"The solubility of dynamic isomerides." By T. M. Lowry.

"Isomeric partially racemic salts containing quinquevalent nitrogen. Part X. The four isomeric hydrindamine *d*-chlorocamphorsulphonates, $NR_1R_2H_3$." By F. S. Kipping.

"Isomeric compounds of the type $NR_1R_2H_3$." By F. S. Kipping.

"The hydrolysis of ethyl mandelate by the fat splitting enzyme, lipase." By H. D. Dakin.

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Issued 12/6/03

PROCEEDINGS

OF THE

CHEMICAL SOCIETY.

Vol. 19. **No. 268.**

Thursday, June 4th, 1903. Dr. W. H. PERKIN, F.R.S., Vice-President, in the Chair.

Certificates were read for the first time in favour of Messrs.:

Ernest Derwent, 36, Sixth and Railroad, Ironton, Ohio, U.S.A.
William Forster, 6, North Railway Street, Seaham Harbour.
Edwin Reginald Hughes, 106, Queen Victoria Street, London, E.C.
Walter Ernest Jennings, 8, Rawdon Terrace, Ashby de la Zouch.
William Parry, B.Sc., 23, Mount Pleasant, Waterloo, Liverpool.

The following certificate was authorised by Council under Bye-Law I (3).

Wilfrid William Ogilvy Beveridge, A.M.S. Laboratory, Pretoria.

Of the following papers, those marked * were read:

*83. "Formation of an anhydride of camphoryloxime." By T. M. Lowry.

When nitrocamphor is boiled with concentrated hydrochloric acid, the greater part of the substance passes into solution and is converted into camphoryloxime. During the investigation of this isomeric change (*Trans.*, 1898, 73, 1002), a considerable quantity of a resinous by-product was accumulated; this substance has now been examined and found to contain an *anhydride*, $\begin{matrix} C_8H_{14} \\ CO-O \end{matrix}\!\!>\!C{:}N{\cdot}O{\cdot}N{:}C\!<\!\!\begin{matrix} C_8H_{14} \\ O{\cdot}CO \end{matrix}$, of *camphoryloxime*, which, after crystallisation from alcohol, softens at about 215°, melts at 220°, and has $[\alpha]_D = +26°$ in acetone.

*84. "Mutarotation of glucose as influenced by acids, bases and salts." By T. M. Lowry.

Both acids and bases have an accelerating effect on the mutarotation of glucose, whilst potassium chloride is without influence. If the mutarotation is conditioned by the presence in the glucose of an exceedingly minute quantity of basic impurity or a somewhat larger amount of acid impurity, a retardation should be produced when the base or acid is neutralised by adding hydrogen chloride or potassium hydroxide respectively. Careful quantitative experiments showed that this retardation does not occur, and the conclusion is drawn that although the mutarotation is accelerated by both acids and bases, its occurrence is independent of the presence of these impurities. Probably the water alone is sufficient to condition the change if enough impurity is present to render it an electrolyte.

*85. "The solubility of dynamic isomerides." By T. M. Lowry.

Whilst the rotatory power affords a general method for studying the dynamic isomerism of optically active substances, no similar method is available in the case of inactive bodies. The measurements of electrical conductivity, so effectively employed by Hantzsch in the study of pseudo-acids, pseudo-salts, and pseudo-bases, can only be made when one of the isomerides is an electrolyte and at least moderately soluble in water. Of the other physical properties, density, molecular solution volume, refractive index, dispersion, and magnetic rotatory power differ relatively little in isomeric compounds, and the melting point, colour and ultra-violet absorption cannot easily be made the

basis of quantitative measurements. The solubility of dynamic isomerides is, however, usually very different, and under certain conditions it is possible to follow experimentally the gradual change of solubility as a substance is converted into a dynamic isomeride. This method, which has been devised and tested in the case of optically active substances, will, it is believed, be of service in the study of inactive bodies, and thus render possible the quantitative examination of many changes that have hitherto been examined only qualitatively.

If the less soluble isomeride is initially in contact with the solvent, the solubility gradually increases until the liquid phase contains a normal proportion of the two forms. If, however, the more soluble isomeride is used, the solubility increases until the liquid is saturated with both forms; the solution then contains a much greater proportion of the more soluble isomeride and isomeric change proceeds continuously, the more soluble modification dissolving whilst the less soluble form separates from the solution; finally, when the whole of the more soluble form has dissolved, the solubility decreases to a constant value identical with that obtained when the less soluble isomeride alone is used.

Measurements of the solubility of pseudo-β-bromonitrocamphor in benzene show that at 10° the solubility gradually increases from 2·3 to 9·3 grams per 100 grams of benzene, whilst when both forms are present in the solid phase the solution contains nearly 14 per cent. of the substances.

***86. "The rusting of iron." By G. T. Moody.**

The contention of Dunstan (*Proceedings of the Royal Artillery Institution*, 1899, No. 5, 26; this vol. p. 150) that carbon dioxide is not essentially concerned in the process of rusting and that this change is caused by hydrogen peroxide is based on the observation that solutions of chromium trioxide, potassium dichromate, potassium ferrocyanide, sodium nitrite and other substances which decompose hydrogen peroxide, entirely or nearly entirely prevent rusting. The author finds that the retarding action exercised by these substances is due to the influence they exert on the absorption of carbon dioxide. For example, when exposed to the gas under exactly the same conditions, water absorbed 90·6 volumes, whilst a 15 per cent. solution of chromium trioxide and a 20 per cent. solution of sodium nitrite absorbed 4·2 volumes and 5·6 volumes respectively. A solution of chromium trioxide—which itself does not attack iron—appears all the more to exert a protecting influence because of the ease with which it dissolves

ferric oxide. Iron, when placed under a 1 per cent. solution of chromium trioxide exposed to air, remains bright for some weeks, although the metal is slowly passing into solution. Eventually rust commences to form on the metal, although the solution still contains free chromic acid.

When iron is exposed to water and oxygen previously freed as far as possible from carbon dioxide, the volume of oxygen remains practically unchanged. On admitting carbon dioxide, the volume of oxygen diminishes rapidly and rusting becomes visible.

The interaction of iron with aqueous carbonic acid appears to be strictly comparable with that occurring between iron and sulphuric acid. A solution of carbonic acid, formed by saturating 2·4 litres of water at 18° with carbon dioxide, when left in contact with 500 grams of clean iron turnings yielded 635 c.c. of hydrogen in 7 days. After remaining for one week, the solution contained 0·1 per cent. of iron present as ferrous bicarbonate, a substance which is readily decomposed by atmospheric oxygen yielding a mixture of ferrous carbonate and ferric oxide, whilst a part of the carbonic acid is regenerated. On account of the ease with which this change takes place, it follows that in presence of oxygen a definite weight of carbonic acid will exert a greater corroding influence on iron than will its equivalent of sulphuric or hydrochloric acid.

The author contends that the primary action in rusting involves the interaction of iron and acid and that rust is formed by the subsequent oxidation of ferrous salt.

Discussion.

Mr. C. E. Groves said it was known that iron immersed in potassium carbonate solution did not rust, and asked whether the author had examined the action on iron of a solution of *potassium* hydrogen carbonate saturated with carbon dioxide. He believed it was not generally known that solid caustic potash containing about 5 per cent. of water, when fused at a gentle heat in contact with steel, readily attacked it, the iron apparently forming a ferrous compound. Fused caustic soda, however, had practically no action on iron.

Dr. Jowett said that, having cooperated with Professor Dunstan in the work to which Dr. Moody had referred, he must point out that much of the criticism seemed to be based on a misunderstanding. The rusting of iron was the sum of several chemical reactions each of which had been separately studied. It was not stated or thought that the oxidation in which hydrogen peroxide might take part constituted the whole phenomenon of rusting, and one of the experiments shown by Dr. Moody, namely, the evolution of hydrogen from a mixture of

aqueous carbonic acid and iron, was referred to in Professor Dunstan's note. The oxidation in which it was suggested that hydrogen peroxide was involved, occurred when oxygen, water, and pure iron were used, and it was a fact that substances which decomposed hydrogen peroxide prevented oxidation under conditions similar to those in which the peroxide was produced during the oxidation of zinc.

Finally, although the analyses of rust produced under ordinary atmospheric conditions generally showed the presence of carbon dioxide, they agreed closely with the formula $Fe_2O_2(OH)_2$, which was also found to represent the composition of the product formed by the oxidation of iron under the conditions previously mentioned.

Dr. Scott asked if the chromic acid was free from sulphuric and nitric acids.

He mentioned that Dr. Russell's experiments on the action of various metals on photographic plates showed that zinc very readily gave hydrogen peroxide and even mercury containing 1/300th per cent. of zinc produced sufficient to affect a photographic plate.

Dr. Kohn asked whether any experiments had been tried on the influence of light on the action of carbonic acid, since many changes effected by air and moisture and attributed to the formation of hydrogen peroxide did not occur or were diminished in absence of light. Such experiments might indicate whether hydrogen peroxide had any contributory action.

Mr. A. C. Chapman asked whether Dr. Moody had assured himself that the amount of hydrogen evolved in the experiment referred to was not greater than that which would correspond with the carbon dioxide present, and also whether he had made any experiments as to the influence of the purity of the iron employed on the quantity of gas evolved. In other words, was the hydrogen solely the result of replacement, or might not some of it have been produced by electrolytic action pure and simple.

Dr. Henry pointed out that in the course of the experiments referred to in Prof. Dunstan's note, a specimen of pure sheet iron with bright surfaces had been immersed for more than six years in a 4 per cent. aqueous solution of chromic acid contained in a loosely stoppered jar; during the whole of that time the surfaces had remained perfectly bright and there was no evidence of either the reduction of the chromic acid or the formation of iron rust, although the solution was in contact with atmospheric carbon dioxide. He suggested that the rusting observed by the author when iron was kept in solutions of dilute chromic acid in presence of carbon dioxide might be due to the employment either of commercial iron or chromic acid containing impurities; it was known that the presence of neutral salts such as

sodium chloride in water in which iron was immersed accelerated the rate of rusting.

Dr. Lowry said that if hydrogen peroxide were a product of the initial stage in the rusting of iron, its destruction by chromic acid might be expected to assist rather than retard the oxidation.

Dr. Moody, in reply, said that in discussing this subject it was necessary to be agreed as to what was meant by rusting. He understood rusting to mean the corrosion taking place when metals were left exposed to air under ordinary conditions. Water condensed from air contains carbonic acid, which in contact with iron immediately gives rise to a ferrous salt. Since ferrous salts equally with chromic acid, sodium nitrate, and potassium ferrocyanide establish a condition in which the production of hydrogen peroxide is inhibited, it follows that the theory advanced by Dunstan can have no bearing on the atmospheric rusting of iron.

87. "Imino-ethers corresponding with ortho-substituted benzenoid amides." By G. D. Lander and F. T. Jewson.

Pinner's method of synthesis of imino-ethers fails either partially or completely with aryl cyanides containing an *ortho*-substituent, and one of the authors has shown that the main product of the action of ethyl iodide and dry silver oxide on *o*-toluamide in boiling alcoholic solution is a nitrile (*Trans.*, 1901, 77, 695).

When boiling alcohol is employed as a medium, the alkylation of other amides by this method seems to be characterised by the formation of nitriles, but whilst the yield of imino-ether from *o*-toluamide is only 13·6 per cent., the proportion is 70 per cent. in the case of *p*-toluamide; this result is explained by supposing that the *o*-compound more readily loses alcohol than its *p*-isomeride, $C_7H_7\cdot C(:NH)\cdot OEt = C_7H_7\cdot CN + EtOH$. The same constitutive factor, however, renders the *o*-imino-ether more stable as regards hydrolysis by aqueous hydrochloric acid, $C_7H_7C(:NH)\cdot OEt + H_2O + HCl = C_7H_7\cdot CO_2Et + NH_4Cl$.

Although better yields of the imino-ether are obtained when the synthesis is carried out in boiling ethereal solution, yet in this case, nitrile is also produced.

The *hydrochloride* of *o*-chlorobenziminoethyl ether decomposes at 105°, yielding *o*-chlorobenzamide; the *methyl* analogue forms a *hydrochloride* which decomposes at about 110°. *o-Chlorobenzmethylamide* is also a product of the methylation of *o*-chlorobenzamide, and forms colourless needles melting at 92—94°. *o-Toluiminomethyl ether* was prepared by the action of methyl iodide on the silver derivative of *o*-toluamide; its *hydrochloride* decomposes between 110° and 115°.

o-Toluiminoethyl ether, when mixed with nitrile, distils without change between 106° and 118° under 20—25 mm. pressure, and yields a *hydrochloride* which decomposes at 105—106°.

88. "The hydrolysis of ethyl mandelate by lipase." By H. D. Dakin.

Optical isomerides are frequently very differently affected by enzymes as well as by living organisms, but the production of an optically active substance from inactive material as the result of simple enzyme action has not hitherto been conclusively demonstrated.

If the conception of an enzyme as an optically active asymmetric complex is correct, and, morever, if combination occurred between the enzyme and the substance acted on, it should be possible to show that when an enzyme acts on an optically inactive substance, the two optical components are decomposed with unequal velocity.

This was shown to be the case when inactive ethyl mandelate was hydrolysed by the enzyme lipase. In all cases, provided hydrolysis was incomplete, the separated mandelic acid was found to be strongly dextrorotatory whilst the unchanged ester was lævorotatory.

The reaction would appear to bear a close analogy to the hydrolysis of esters prepared from an optically active alcohol and an inactive acid (Marckwald and McKenzie, *Ber.*, 1901, **34**, 469).

89. "Isomeric change in benzene derivatives. The conditions influencing the interchange of halogen and hydroxyl in benzenediazonium hydroxides." By K. J. P. Orton.

The supposed *s*-tribromophenylnitrosoamine, obtained by Hantzsch and Pohl (*Ber.*, 1902, **35**, 2964) from *s*-tribromobenzenediazonium acetate under conditions which, according to the author's earlier investigations (*Proc. Roy. Soc.*, 1903, **71**, 153), are favourable to the replacement by hydroxyl of the bromine atom in the ortho-position relatively to the diazo-group, is now shown, by an exact repetition of Hantzsch and Pohl's experiments, to consist of a mixture of 3 : 5-dibromo-*o*-quinonediazide (3 : 5-dibromo-*o*-diazophenol) and an amorphous condensation product, probably a hydroxyazo-derivative, either when prepared from the diazonium salt or from the corresponding alkali diazo-oxide (diazotate). Moreover, the hydrochloride obtained by Hantzsch and Pohl by passing hydrogen chloride into an ethereal solution of the original yellow material and thought by them to be the hydrochloride of the nitrosoamine, is, in fact, the hydrochloride of the quinonediazide, which can readily be prepared from it by hydrolysis with water.

The transformation of the diazonium acetates derived from 2 : 4 : 6-tribromo-3-nitroaniline, 2 : 3 : 4 : 6-tetrabromoaniline, 3 : 5-dibromo-*p*-toluidine, 2 : 6-dibromoaniline, 2 : 4-dichloroaniline, and 2 : 4-dibromo-5-nitroaniline have been examined. When a nitro-group is in the meta-position relatively to the diazo-group, the replacement of the *o*- or *p*-bromine atom by hydroxyl takes place very readily, the diazo-compound in this respect resembling the naphthalene derivatives (*Proc.*, 1902, 18, 252). It is remarkable that 3 : 5-dibromo-*p*-toluenediazonium acetate does not lose bromine.

2 : 6-Dibromobenzenediazonium acetate slowly undergoes this change, but chlorine ions are scarcely appreciable in a solution of 2 : 4-dichlorobenzenediazonium acetate, even after several days. Bromine is, however, rapidly displaced when a nitro-group is in the meta-position relatively to the diazo-group, as in the 2 : 4-dibromo-5-nitrobenzene diazo-compounds.

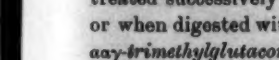
This interchange takes place not only with the diazonium acetates and hydrogen carbonates, but also in a similar manner with the salts of other weak acids, such as the cyanides and the nitrites, but with these salts, however, other reactions occur simultaneously, thus 2 : 4 : 6-tribromo-1-nitrobenzene is also formed from the nitrite.

When the diazonium salt is present as sulphate, the change is extremely slow at the ordinary temperature, but at 80° nearly one atomic proportion of bromine is eliminated in four hours, a fact which no doubt accounts for the apparent impossibility of obtaining *s*-tribromophenol by heating aqueous solutions of *s*-tribromobenzenediazonium salts.

The following substances were described : 2 : 4 : 6-*tribromobenzeneazo-β-naphthol*, melting at 173—174°; 3 : 5-*dibromophenol*-2-*azo*-β-*naphthol*, copper-coloured plates melting at 214—215°; 3 : 5-*dibromo*-2-*nitro*-p-*quinonediazide* (3 : 5-*dibromo*-2-*nitro*-p-*diazophenol*), prepared from 2 : 4 : 6-tribromo-3-nitroaniline, crystallises in yellow plates decomposing at 196°; *tribromoquinonediazide* (*tribromodiazophenol*), prepared from 2 : 3 : 4 : 6-tetrabromoaniline, forms orange crystals melting and decomposing at 124°; 3-*bromo*-o-*quinonediazide* (3-*bromo*-o-*diazophenol*), prepared from 2 : 6-dibromoaniline, crystallises in orange needles melting and decomposing at 103°; 2 : 4-*dichlorobenzeneazo-β-naphthol*, scarlet prisms melting at 190°; *chlorophenolazo-β-naphthol*, minute needles melting at 265°; 3 : 5-*dibromo*-p-*toluneazo-β-naphthol*, scarlet prisms melting at 141°.

90. "The synthesis of *aaγ*-trimethylglutaric acid, of the *cis*- and *trans*-modifications of *β*-hydroxy-*aaγ*-trimethylglutaric acid, and of *aaγ*-trimethylglutaconic acid." By W. H. Perkin, jun., and Alice E. Smith.

A mixture of ethyl dimethylmalonate and ethyl acetate is readily acted on by sodium, yielding the sodium compound of ethyl *aa*-dimethylacetonedicarboxylate, $CO_2Et\cdot CMe_2\cdot CO\cdot CHNa\cdot CO_2Et$, and if this is treated with methyl iodide, *ethyl aaγ-trimethylacetonedicarboxylate*, $CO_2Et\cdot CMe_2\cdot CO\cdot CHMe\cdot CO_2Et$, is produced as a nearly colourless oil boiling at 195—197° under 100 mm. pressure, which, in alcoholic solution, gives a violet coloration with ferric chloride. When this ester is reduced with sodium amalgam, it yields a mixture of the *cis*- and *trans*-modifications of *β-hydroxy-aaγ-trimethylglutaric acid*, $CO_2H\cdot CMe_2\cdot CH(OH)\cdot CHMe\cdot CO_2H$. The *trans*-acid melts at 155° and when rapidly heated under reduced pressure distils with very little decomposition. The *cis*-acid melts at 115° and on distillation yields a crystalline substance, $C_8H_{10}O_3$, which melts at 88° and is probably the anhydride of *cis-aaγ-trimethylglutaconic acid*,



Both the *cis*- and *trans*-modifications of the hydroxy-acid, when treated successively with phosphorus pentachloride and diethylaniline, or when digested with fuming hydriodic acid, are converted into *trans-aaγ-trimethylglutaconic acid*; this acid, which melts at 150° and, when heated in small quantities, volatilises to a certain extent without decomposition, is reduced with difficulty, but by the action of a large excess of alcohol and sodium becomes converted into *aaγ-trimethylglutaric acid*, $CO_2H\cdot CMe_2\cdot CH_2\cdot CHMe\cdot CO_2H$, melting at 98°. When subjected to the action of dry bromine vapour, *trans-aaγ*-trimethylglutaconic acid is converted into *βγ-dibromo-aaγ-trimethylglutaric acid*, which crystallises from formic acid and melts at 205—207°.

91. "Hexamethyleneoctocarboxylic acid and the *cis*- and *trans*-modifications of hexamethylenetetracarboxylic acid (hexahydropyromellitic acid)." By T. W. D. Gregory and W. H. Perkin, jun.

When ethyl propanetetracarboxylate, $(CO_2Et)_2CH\cdot CH_2\cdot CH(CO_2Et)_2$, is treated with bromine, it yields *ethyl dibromopropanetetracarboxylate*, $(CO_2Et)_2CBr\cdot CH_2\cdot CBr(CO_2Et)_2$, which melts at 55°.

This bromo-ester reacts with the disodium compound of ethyl

propanetetracarboxylate giving an almost quantitative yield of *ethyl hexamethyleneoctocarboxylate*, $\begin{matrix}(CO_2Et)_2\cdot C\cdot CH_2\cdot C\cdot(CO_2Et)_2\\ (CO_2Et)_2\cdot C\cdot CH_2\cdot C\cdot(CO_2Et)_2\end{matrix}$, a colourless, crystalline substance (m. p. 46°), which, when digested with hydrochloric acid, yields the free *hexamethyleneoctocarboxylic acid*; this substance decomposes at 218°, giving rise to the *cis*- and *trans*-modifications of *hexamethylenetetracarboxylic acid*, $\begin{matrix}CO_2H\cdot CH\cdot CH_2\cdot CH\cdot CO_2H\\ CO_2H\cdot CH\cdot CH_2\cdot CH\cdot CO_2H\end{matrix}$. The *cis*-acid melts at 140°, and its *anhydride* at 60°; the *trans*-acid melts at 175°, and yields the latter compound on digestion with acetic anhydride and subsequent distillation.

92. "The bases contained in Scottish shale oil. Part II." By F. C. Garrett and J. A. Smythe.

The only bases obtained in a state of purity from the fractions of Scottish shale oil boiling between 164° and 180° are 2 : 3-*dimethylpyridine* and 2 : 4 : 6-trimethylpyridine. The lower homologue, which has not been described, is a liquid lighter than, and insoluble in, water, having a pleasant aromatic smell and boiling at 163—164° under 768 mm. pressure. Its mercurichloride melts at 120° and its aurichloride at 96°; its platinichloride melts and decomposes at 216°. The trimethylpyridine boils at 171° under 768 mm. pressure and gives an aurichloride containing one molecule of water of crystallisation and melting at 53°; when anhydrous, the salt melts at 112°.

93. "A direct method for determining the latent heat of evaporation." By J. Campbell Brown.

The latent heats of thirteen alcohols, seven acids, and twenty-eight esters have been directly determined by means of an apparatus adapted for ascertaining the weight of liquid evaporated by a determinate amount of heat applied at the boiling point of the substance, when this is surrounded by a double jacket containing its own vapour.

94. "Isomeric partially racemic salts containing quinquevalent nitrogen. Part X. The four isomeric hydrindamine *d*-chlorocamphorsulphonates, $NR_1R_2H_3$." By F. S. Kipping.

The isomeric partially racemic α- and β-salts obtained from *dl*-hydrindamine and *d*-chlorocamphorsulphonic acid (*Trans.*, 1900, 77, 889) are not resolved into their components under conditions

similar to those employed in the resolution of the corresponding bromo-salts (*Proc.*, 1902, 18, 209), but the four isomeric salts of the type $NR_1R_2H_3$, from which the partially racemic compounds are formed, have been isolated and examined.

d-Hydrindamine, prepared from the pure *ad*-bromo-salt (previously denoted αA-salt, *Proc.*, *loc. cit.*), combines with *d*-chlorocamphorsulphonic acid giving rise to two isomeric salts, one of which is formed in relatively very small quantities. The principal product, which corresponds with the *ad*-bromo-salt and is distinguished as the *ad*-isomeride, is easily obtained in a pure condition; it separates from water in well-defined, compact, hydrated crystals, melts at 208—209°, and has a specific rotation $[\alpha]_D = +46°$ in aqueous and $+15{\cdot}5°$ in chloroform solution. It differs greatly in outward properties from the corresponding *ad*-salt of the bromo-acid, and also from all the other three isomeric chloro-salts.

The second product, which corresponds with the *βd*-bromo-salt (previously denoted βA-salt), is only obtained in a pure condition after a long course of fractional crystallisations; it separates from water in long, hydrated needles, melts at 202—203°, and its specific rotation in aqueous solution is $[\alpha]_D = +59°$, the value in chloroform being $[\alpha]_D = +50°$.

The great difference between these isomerides is very noteworthy considering the fact that the corresponding bromocamphorsulphonates of hydrindamine and of methylhydrindamine (Tattersall and Kipping, this vol., p. 145) are so similar that the *βd*-isomeride cannot be obtained in a pure state.

The pure *ad*-hydrindamine chlorocamphorsulphonate, decomposed with barium hydroxide solution, gives both the *ad*- and the *βd*-isomerides when regenerated from its component acid and base, a proof that these two salts are formed from structurally and optically identical components.

l-Hydrindamine, prepared from the pure *al*-modification (previously denoted αB) of the bromo-salt, also combines with *d*-chlorocamphorsulphonic acid giving rise to a mixture of very unequal quantities of two isomeric salts. The principal product, the *al*-modification, corresponding with the *al*-bromo-salt, separates from water in long, anhydrous needles, indistinguishable in appearance from those of the *al*-bromo-compound; it melts at 118—119° and has a specific rotation $[\alpha]_D = +44°$ in aqueous and $+45{\cdot}5°$ in chloroform solution. The subsidiary product, namely, the *βl*-isomeride (formerly denoted βB), is only separated in a pure condition with very great difficulty; it crystallises from water in long, anhydrous needles which generally melt at about 140—145°, the indefinite melting point being apparently due to dimorphism, as in

the case of the corresponding bromo-isomeride. Its specific rotation is $[\alpha]_D = +57{\cdot}5°$ in aqueous and $+60{\cdot}5°$ in chloroform solution.

When the pure *al*-chloro-salt is decomposed with barium hydroxide solution and then regenerated from its own acid and its own base, a mixture of the *al*- and *βl*-isomerides is obtained, just as from the original *l*-base.

It is to be noted that the *βd*- and *βl*-chloro-salts have a much *higher* molecular rotation than that of *d*-chlorocamphorsulphonic acid, whereas in the case of the corresponding bromo-salts the position is reversed; it follows, therefore, that the formation of these isomerides cannot be attributed to any partial racemisation of the acid or the base.

The isolation of these four isomeric hydrindamine *d*-chlorocamphorsulphonates seems to afford the final proof that the author's explanation of the existence of the partially racemic α- and β-salts is the true one (*Trans., loc. cit.*).

95. "Isomeric compounds of the type $NR_1R_2H_3$." By F. S. Kipping.

The isolation of the four isomeric hydrindamine *d*-chlorocamphorsulphonates (see previous abstract), the proof of the existence of four isomeric methylhydrindamine bromocamphorsulphonates (derived from one *dl*-base) (Tattersall and Kipping, this vol., 145), and other evidence fully confirm the author's views as to the nature of the isomeric partially racemic salts which have been previously studied (Kipping, *Trans.*, 1900, 77, 861; 1901, 79, 430), and establish the occurrence of isomerism in compounds of the type $NR_1R_2H_3$ (*Proc.*, 1902, 18, 211).

The stability of the isomeric salts in aqueous solution leads to the conclusion that there are two different ions NR_1H_3– for each optically active base, and, consequently, it should be possible to transfer such ions from one acid to another without altering the configurations particular to them. Experiments bear out this conclusion. The partially racemic β-salt of hydrindamine and *d*-bromocamphorsulphonic acid is not converted into the corresponding α-salt when it is repeatedly evaporated first with concentrated hydrochloric acid and then with water, or when it is successively treated in aqueous solution with sodium carbonate and hydrochloric acid, the solution being then evaporated. The four basic ions of the β-salt can thus be transferred from the bromo-acid to hydrochloric or to carbonic acid, and back again to the bromo-acid without altering their relative proportions as long as the base is never in the free state.

The platinichlorides, prepared from the *ad*-, *al*-, and *βl*-modifications [previously called the αA-, αB-, and βB-modifications respectively (*Proc.*, 1902, 18, 209)] of hydrindamine *d*-bromocamphorsulphonate by precipitating in presence of hydrochloric acid, seem to be identical in outward properties, and the hydrochlorides obtained from the platinichlorides by decomposing with hydrogen sulphide are also indistinguishable in appearance and in melting point; it would seem, nevertheless, that each of the optically active hydrindamines gives rise to two different hydrochlorides (indistinguishable in ordinary properties), firstly, because of the behaviour of the partially racemic *β*-salt (see above), and, secondly, because the *βl*-modification of hydrindamine *d*-chlorocamphorsulphonate can be converted into a hydrochloride from which the original *βl*-salt is obtained on evaporating with the chloro-acid.

The hydrochloride, prepared from the above-mentioned *βl*-bromo-salt, gave with ammonium *d*-bromocamphorsulphonate what appeared to be the pure *βl*-isomeride, but on repeating the experiment under different conditions, starting from the *βl*-chloro-salt, the *al*-modification was obtained: further investigation is necessary before this difference in behaviour can be explained, but it seems reasonable to conclude that *four isomeric hydrochlorides* of hydrindamine are capable of existence.

The molecular rotations of the *ad*- and *al*-salts in dilute aqueous solution are in all cases practically normal, but the *βd*- and *βl*-hydrindamine bromocamphorsulphonates give values which are far too low, whereas the *βd*- and *βl*-hydrindamine chlorocamphorsulphonates give numbers which are far too high; molecular weight determinations in boiling aqueous solution seem to indicate that the salts of the *β*-series are not so highly dissociated as the corresponding α-salts, but the evidence is very inconclusive.

The existence of isomeric salts of the type $NR_1R_2H_3$ can be accounted for by assuming that the five valencies of the nitrogen atom are directed from the centre to the angles of a square-based pyramid, but in view of the highly conflicting experimental evidence bearing on the question of the configuration of the nitrogen atom, this subject cannot yet be profitably discussed; even in the case of trivalent nitrogen, there is great uncertainty, as no case is yet known of isomerides of the type $NR_1R_2R_3$, although the existence of such compounds is a probable, if not a necessary, consequence of the hypothesis of Hantzsch and Werner.

ADDITIONS TO THE LIBRARY.

III. *Pamphlets.*

Schiff, Ugo. Separazione delle funzioni basica ed acida per mezzo della formaldeide. (*From the Gazz. Chim. Ital.*, 33, pt. I, 1903.)

Speroni, C. Di alcuni derivati aldeidici del solfito di anilina. (*From the Gazz. Chim. Ital.*, 33, pt. I, 1903.)

Van Slyke, L. L. Some facts about commercial fertilizers in New York State. (*Being Bull. No.* 230, *New York Agric. Exper. Station*, 1903.)

Van Slyke, L. L., and E. B. Hart. The relation of carbon dioxide to proteolysis in the ripening of cheddar cheese. (*Being Bull. No.* 231, *New York Agric. Exper. Station*, 1903.)

Voelcker, J. A., and A. D. Hall. The valuation of unexhausted manures obtained by the consumption of foods by stock.

Wiley, H. W. Manufacture of table syrups from sugar cane. (*Being U.S. Dept. of Agric. Bureau of Chemistry, Bull. No.* 53.)

At the next meeting, on **Wednesday, June 17th, at 5.30 p.m.**, there will be a ballot for the election of Fellows, and the following papers will be communicated :—

"The electrolytic estimation of minute quantities of arsenic, more especially in brewing materials." By T. E. Thorpe.

"The estimation of arsenic in fuel." By T. E. Thorpe.

"Crystallised ammonium sulphate and the position of ammonium in the alkali series." A. E. H. Tutton.

"Action of hydrogen on sodium." By A. Holt, jun.

"The action of halogens on compounds containing the carbonyl group." By A. Lapworth.

"Reactions involving the addition of hydrogen cyanide to carbon compounds." By A. Lapworth.

"The acetoacetic ester synthesis." By A. C. O. Hann and A. Lapworth.

"Rimu resin." By T. H. Easterfield and B. C. Aston.

"Note on the Karaka fruit." By T. H. Easterfield and B. C. Aston.

"The slow oxidation of methane at low temperatures. Part II." By W. A. Bone and R. V. Wheeler.

CERTIFICATES OF CANDIDATES FOR ELECTION AT THE NEXT BALLOT.

N.B.—The names of those who sign from "General Knowledge" are printed in *italics*.

The following Candidates have been proposed for election. A ballot will be held on Wednesday, June 17th, 1903.

Aubrey, Henry James,
The Cross, Worcester.

Analytical and Research Chemist. Member Pharmaceutical Society Gt. Britain. Certificated Society Apothecaries, London. Original work done on the treatment of hop yards for the destruction of blight, &c.

Herbert S. Shorthouse. Wallace C. Nickels.
W. S. Howie. Charles Bayliss.
Geo. E. Perry.

Barger, George,
50, Guilford Street, W.C.

Physiological chemist at the Wellcome Research Laboratories, Herne Hill, S.E. B.A. (Cantab.), B.Sc. (Lond.); late assistant at the Botanical Institute, Brussels University; engaged in physiological chemical research; published a paper in *Ber. d. deutsch. Chem. Gesellsch.*, 1902.

S. Ruhemann. W. J. Sell.
Charles T. Heycock. F. W. Dootson.
H. O. Jones.

Bennett, Colin Noel,
95, High Street, Camden Town, N.W.

Student Chemical Laboratory, University College, London. For

the last 2½ years student at Chemical Laboratory, University College, London.

J. Norman Collie. Alex. W. Bain.
Edward C. Cyril Baly. S. E. Sheppard.
Morris W. Travers. William Ramsay.

Bibby, Charles Drake,
69, Queens Road, Twickenham, Middlesex.

Chemist. Assistant in the Chemical Laboratory of Messrs. Burgoyne, Burbidges and Co., 1894 to 1899. Assistant Chemist in the Laboratories of the Pharmacie Centrale de France, Saint-Denis (Seine), 1899 to 1900. Student of Physiological Chemistry at King's College, London. At present Chemist in the Laboratory of Messrs. Parke, Davis and Co., Hounslow.

Thos. Farries. Theophilus Pitt.
Reginald G. Halstead. Georges Ponthieu.
Alf. J. Parker.

Brennand, Henry John Wolverton,
203, Macquarie Street, Sydney.

Medical Practitioner, employed as an Officer of the Government Statistician of New South Wales. Bachelor of Arts, Bachelor of Medicine, Master of Surgery, of the University of Sydney. (Honours in Chemistry.) At present engaged in the study of Physiological Chemistry. Formerly Teacher of Chemistry at Newington College, Sydney. Member of Royal Society of New South Wales.

A. Liversidge. F. B. Guthrie.
J. A. Schofield. *Basil Turner.*
William M. Hamlet.

Burghard, William Godsell,
180, High Holborn, W.C.

Student. Have studied Chemistry, Physics, Biology, Mathematics, and Geology since 1894 at the Birkbeck Literary and Scientific Institution and elsewhere. Hold Science and Art Department Certificates for Organic and Inorganic Chemistry. Now engaged in private chemical research work.

John E. Mackenzie. H. F. C. Goltz.
J. Woodward. Wm. W. S. Nicholls.
Edward Jones.

Bury, Ernest, M.Sc.

Brackley Coke Works, Little Hulton, near Bolton, Lancs.

Chemist to the Bridgewater Trustees, and Superintendent of the Brackley Coke Works. Student in the Chemical Department, Owens College, Manchester, 1891—1895. Graduated B.Sc. (Vict. Honours School of Chemistry) in 1895, and M.Sc. in 1899. Since 1895, he has filled the post of chemist to the Bridgewater Trustees, and is now in charge of their Brackley Bye-Product Coke Works at Little Hulton, near Bolton, Lancs.

W. H. Perkin, jun.	Norman Smith.
Harold B. Dixon.	G. H. Bailey
J. F. Thorpe.	William A. Bone.

D. L. Chapman.

Campbell, Thomas,

38, Eastbourne Street, Liverpool.

Science Master at St. Bede's Grammar School, Bradford. Winner of two open Science Scholarships (£35 per yr. for 2 years; £65 per year for 3 years) at University Coll., Liverpool (Vict. Univ.), in which Chemistry was one of the subjects. Studied for one session under Dr. Tate at Liverpool School of Science (Chemistry). For 2 years was a student (Science) of University College, Liverpool. For 1 year was a student (Science) of Yorkshire College, Leeds (Victoria University). Have passed Inter. B.Sc. (Vict.) with Chemistry as one of the subjects. Have taught Chemistry (Theor. and Prac.) at above School since September last.

W. Ramshaw.	George Tate.
Ernest Bowman Ludlam.	*Geo. E. Welch.*
J. Campbell Brown.	*W. Collingwood Williams.*
Wm. B. Davidson.	*Robert C. Farmer.*

Carrier, Albert James,

30, Kingwood Road, Oldfield Park West, Bath.

Teaching. I have worked in the laboratories of the Bath City Analyst, of the Bath Technical Schools, and of the Bristol Merchant Venturers' College, passing from the last named the Board of Education examinations in Theoret. and Pract. Chem. (Honours, Part. II), and also the B.Sc. exam. of the London University with 1st Class Honours in Chem. Since Sept. 1901, lecturer at the Bristol Merchant Venturers' College

J. Wertheimer.	Arnold Philip.
G. P. Darnell-Smith.	Albert E. Thomas.

John E. Mackenzie.

Fairhall, Edwin Jesse,

29, Winsham Grove, London, S.W.

Analytical and research chemist in works. Four years at Central Technical College, South Kensington.

Henry E. Armstrong. T. M. Lowry.
William A. Davis. Edward W. Lewis.
A. J. Cownley.

Gandy, William Hunter,

Bradley Court, Mitcheldean, Gloucester.

Principal of Farm and Colonial School. Have passed London Int. B. Science examination in Chemistry, &c. Lecturer in Chemistry, both Agricultural and General, at Wellington Hall Agricultural School from 1895—1900. Lecturer in Chemistry at Norfolk Military College, Overstrand, Cromer, from 1900—1902. I have classes in Chemistry here.

R. Bodmer. *Fred. J. Lloyd.*
Basil Wm. Valentin *Bernard Dyer.*
J. A. Basker. *W. P. Skertchly.*
Alfred C. Chapman.

Harmer, Francis Gerald,

14, Tivoli Place, Ilkley. Address for Letters, &c., Middle Class School, Leeds.

Schoolmaster (Secondary School and School of Science—Headmaster). Headmaster of School of Science. Teacher of Chemistry (in above), Leeds, 8 years, and also in London for 4 years. Lecturer in Evening Science and Art Classes in London 4 years.

Arthur Smithells. Wm. A. Knight.
W. Ludford Freeman. W. B. Hards.
Thomas Hartley.

King, Frank William George,

15, Almond Road, Lower Tottenham, N.

Chemist to the "Veda Food Company," Edinburgh. Studied Chemistry under Dr. J. T. Hewitt for 2 years. Junior Assistant to Dr. Bernard Dyer 1½ years. Assistant to J. Heron, Esq., 2 years.

Bernard Dyer. J. F. H. Gilbard.
John Heron. J. T. Hewitt.
Frank E. King.

Levy, Henry Wolff,

Christian & Levy, 423B, Chancery Lane, Melbourne.

Assayer, Metallurgist, and Chemical Analyst, and member of the above firm, has studied Chemistry for four years under the tuition of Messrs A. H. Jackson, B.Sc., F.C.S., M.I.E.E., &c, David Avery, M.Sc., Heber Green, M.Sc., &c., and has spent some two years studying in the Laboratory and working on Messrs. Jaques Bros. Metallurgical Plant, Richmond. He is one of the Founders and Honorary Secretary of the newly-formed Institute of Analysts, Assayers, and Metallurgists, Victoria, and is at present engaged on research work in connection with titanium. As he is desirous of admission into the Chemical Society in order to receive their publications so as to keep in touch with Chemical Progress, we, the undersigned, propose and recommend him as a proper person to become a Fellow thereof.

Frederic Dunn. A. H. Jackson.
Robert Law. Francis R. Power.

Fred. W. Steel.

Linday, John Howard,

Fenton Hall, Gt. Fenton, Stoke-on-Trent.

Assistant Analytical Chemist. Studied at Ackworth School under Dr. Lean, and at Longton under Dr. Harris. For two years Assistant Analyst to the Stafford Coal and Iron Co. Am desirous to obtain the Chemical Literature of the Society.

Joseph West. Geo. W. Burman.
Walter Harris. Bevan Lean.

J. Howard Davidson.

Livesey, Charles Edwin Leonard,

23, Swinton Place, Gt. Horton, Bradford.

Science Teacher (Senior Science Master, St. Bede's Grammar School, Bradford). Degree of Bachelor of Science after 3 Years' Course at the Yorkshire College. Two Years' Science Teacher as above (Subjects: Chemistry and Physics).

Arthur Smithells. H. M. Dawson.
Julius B. Cohen. W. Lowson.

Henry R. Procter.

Mann, John Christopher,

9, Lambert Street, Hull.

Manufacturing Chemist, Member Soc. Chem. Industry (since 1891). Fifteen years Analytical and Research Chemist at the Gas Light

and Coke Co.'s Products Works, Beckton, E. At present and for past 5 years Chemist and Manager to Messrs. Major and Co., Ltd., Tar Distillers, &c., Hull,

John William Young. Frank H. Leeds.
J. T. Hewitt. L. J. de Whalley.

Rudolph Messel.

Moore, Alfred Ernest, B.A., B.Sc. (London),
St. John's College, Battersea, S.W.

Lecturer in above College on Mathematics and Physical Science. Fourteen years Lecturer in Chemistry, and for Seven years Senior Lecturer in Physical Science, a position held at present.

Edgar E. Horwill. Frank E. Weston.
J. Bernard Coleman. *J. C. Crocker.*

Frank Clowes.

Moore, Arthur,
83, Elgin Road, Seven Kings, Essex.

Student of Chemistry, both Organic and Inorganic, 5 years at City of London College, Moorfields. Holder of several certificates in Chemistry, Board of Education. Anxious to possess the Chemical Society's Journal.

Isaac S. Scarf. Jos. S. Bridges.
Chas. A. West. Harold W. Harrie.

Thos. Tyrer.

Norman, George Marshall,
5, Watford Villas, Battersea Park, S.W.

Student Demonstrator. Associate of Royal College of Science and of Institute of Chemistry and Bachelor of Science, London Univ.

William A. Tilden. H. Burrows.
M. O. Forster. Chapman Jones.
G. T. Morgan. James C. Philip.

Parry, George Harry,
The Level, Brierley Hill, Staffs.

Head Chemist, Earl of Dudley, Level New Furnaces, Brierley Hill. Educated at Stourbridge Grammar School, where took Chemistry; afterwards studied under W. Whitehouse, Esq., Wolverhampton, and F. Thompson, Esq., F.C.S., Dudley; with H. Silvester, Esq., F.C.S., F.I.C., Borough Analyst, West Bromwich, Do., Do., Dudley, first as pupil, afterwards chief assistant 3 years. I am now Head Chemist to

The Rt. Hon. The Earl of Dudley, Level New Furnaces, Brierley Hill, and have been so ten years.

Harry Silvester. Robt. D. Connell.
W. H. Pearson. *A. E. McKenzie.*
James E. Ferguson.

Purcell, Charles Stanley,

37, Acomb St., Greenheys, Manchester.

Assistant Chemist. A Student for three years in the Brewing Depart. of the School of Technology, Manchester. Has obtained the Honours Certificate of City and Guilds in Brewing. Honours in Chemistry of Board of Education. Assistant Chemist to Messrs. Robertson and Sons, Manchester.

William J. Pope. L. G. Radcliffe.
Jas. Grant. F. S. Sinnatt.
S. J. Peachey. J. Hübner.

Rhind, Thomas,

69, Gloucester Road, Regent's Park, London, N.W.

Medical Practitioner. Member of Royal College of Surgeons, Eng. Licentiate of Royal College of Physicians, London. Studying Sanitary Science and Chemistry.

R. E. S. Richardson. H. N. B. Richardson.
Lewis Ough. Henry Kenwood.
John Attfield.

Smith, Charles Joseph,

Sunnydale, Walton New Road, Stockton Heath.

Brewer. Chemist at Messrs. Peter Walker and Son, Ltd., Warrington, Brewers. Member of Institute of Brewing. First class certificate for Brewing, Examination for which comprised Practical and Scientific Brewing and the Chemistry of Brewing; First class certificates for Practical and Theoretical Inorganic and Organic Chemistry. For five years a student under Mr. F. G. Ruddock, F.I.C., Soc. Pub. Analysts.

Jas. Grant. J. Rymer Young.
L. G. Radcliffe. *F. S. Sinnatt.*
S. J. Peachey.

Smith, James Cruickshank, B.Sc.,

57, Great Ormond Street, Russell Square, W.C.

Professional and business address, 20, Nassau Street, Mortimer Street, W. Technical Chemist (Member of the Society of Chemical Industry, Member of the Society of Arts). Formerly Chief Assistant

"Young" Laboratory of Technological Chemistry, Glasgow and West of Scotland Technical College. Afterwards Technical Chemist and Works Manager. Author of "The Manufacture of Paint" (Scott, Greenwood and Co., 1901); "Notes on the Technical Examination, Analysis, and Valuation of Oils and Lubricants" (Lewis, Jameson and Co., 1903), and of numerous Articles and Papers in Scientific and Trade Journals.

Edmund J. Mills. G. G. Henderson.
F. R. Japp. John B. Orr.
William Maitland.

Tyrrell, Dennis,
182, King Street, Norwich.

Chemist and Brewer. Chemist and Brewer for Messrs. Youngs, Crawshay and Youngs, Ltd., Crown Brewery, Norwich. I have also attended classes in connection with S.K. for Chemistry, Organic and Inorganic (Theor. and Prac.), under S. Hewitt, F.C.S., and R. S. Cahill, F.C.S., and am desirous of keeping in touch with the latest progress in Chemical Science.

Francis Sutton. R. S. Cahill.
S. Hewitt. *Philip G. G. Moon.*
Alfred C. Young. *A. Peacock.*
C. E. Womersley.

Van Laer, Norbert,
69, Calais Road, Burton-on-Trent.

Brewer and Chemist to Messrs. Truman, Hanbury, Buxton, & Co., Ltd. For three years a student at the Technical School and Municipal Laboratories of the City of Ghent, Belgium. Also three years' Scientific training at the Professional School of Brewing of Ghent, and a Graduate of the same.

C. O'Sullivan. Chas. Geo. Matthews.
Jas. O'Sullivan. A. L. Stern.
George Harrow. Adrian J. Brown.

Woolhouse, Sidney Herbert,
2, Durham Rd., Lr. Edmonton, London, N.

Science Master, Parmiter's School, Victoria Park, London, N.E. (Teacher since 1889). M.A., B.Sc., Assoc. Royal College of Science, Dublin.

W. N. Hartley. William A. Tilden.
W. E. Adeney. Morris W. Travers.
Hugh Ramage.

The following was authorised by the Council under Bye-Law I. (3):

Beveridge, Wilfrid William Ogilvy,
A.M.S. Laboratory, Pretoria, S.A.

Major Royal Army Medical Corps. In charge of A.M.S. Laboratories for Transvaal, Orange River Colony, and Cape Colony. Written various reports for the Army on Food Stuffs, Disinfectants, etc.

Walter C. C. Pakes. Alex. Crum Brown.
William J. Pope. Leonard Dobbin.

R. CLAY AND SONS, LTD., BREAD ST. HILL, E.C., AND BUNGAY, SUFFOLK.

Issued 1/7/03

PROCEEDINGS

OF THE

CHEMICAL SOCIETY.

Vol. 19. No. 269.

Wednesday, June 17th, 1903. Professor W. A. TILDEN, D.Sc., F.R.S., President, in the Chair.

Messrs. E. S. Beaven and C. Rawson were formally admitted Fellows of the Society.

Certificates were read for the first time in favour of Messrs.:

Percy W. Gent, 792½, Ridge Street, Newark, N.J., U.S.A.
Henry William Lawrence, Wellington, New Zealand.
Herbert Stanley Redfern, B.Sc., Ningpo, China.
Frank Gurney Smith, 7, Luxemburg Gardens, Brook Green, W.

The PRESIDENT gave notice that an EXTRAORDINARY GENERAL MEETING will be held in the Society's Rooms on **Thursday, July 2nd, 1903,** at **6** p.m., to consider the proposal of the Council to make certain alterations in Bye-law I., and in Circulars Nos. 2, 3, and 4 in the Appendix. The proposed changes are:—

I. To alter Bye-law I., page 13, lines 3 and 4, by *deleting* the words "one year."

The Bye-law at present reads:—

". . . . . ; and he shall"
"be entitled, so long as his annual subscription be not one"
"year in arrear, to one copy of the annual publications of"
"the Society. . . . . ."

II. To alter the Circulars in the Appendix as follows:—

In Appendix, No. 2, "Letter notifying the Election of a Member," 5th and 6th lines, p. 26, *delete* the words "the Assistant Secretary." After the words "before admission.*" *add* the words "Payment should be made direct to the Society's Bankers ( ) either by Cheque or Post Office Order crossed a/c 'Chemical Society.' Your remittance should be accompanied by the enclosed Form with your Name and Address filled in."

„ No. 3, "Annual Circular Letter of Treasurer," *delete* from "If paid" to end of circular, and *substitute* the same words as added in No. 2.

„ No. 4, "Annual Circular Letter of Treasurer to Fellows who are two years in arrear of their Subscriptions," *delete* from "Payments should be made" to end of circular, and *substitute* the same words as added in No. 2.

PRESENTATION OF THE LONGSTAFF MEDAL.

The President spoke as follows: We have so recently celebrated the Centenary of the Atomic Theory that it is a matter of interest to notice that, in the award of the Longstaff Medal on the present occasion, we honour the practical fulfilment of the deductions from that great conception. Dalton himself represented in his diagrams atoms of solid bodies like ice arranged with reference to the crystalline form of the solid, but for three-quarters of a century successive writers could merely speculate as to their possible order in space of three dimensions. The discoveries of Pasteur in connection with hemihedrism in crystals, and the study of the lactic acids by Wislicenus, prepared the way for the development of the theory of stereochemistry by Van't Hoff and le Bel in 1874. But while that theory has prospered and has led to innumerable developments in the study of the compounds of carbon, and although it must have been always obvious that if the idea of a tetrahedral configuration was valid for compounds of one element a corresponding idea should be equally

applicable to those of others, the demonstration of the facts upon which such a development must rest has only been accomplished within the last four years.

To Professor William Jackson Pope the Council has awarded the Longstaff Medal, by a unanimous vote, for his researches on the stereochemistry of compounds of elements other than carbon. In 1893, Professors Kipping and Pope prepared the *d*-bromo- and *d*-chlorocamphorsulphonic acids, and by the use of these and other powerful optically-active acids, Mr. Pope has succeeded, not only in resolving into their active components certain racemic bases which had been found irresolvable by the use of tartaric acid, but in 1899, by the use of *d*-camphorsulphonic acid, he separated the dextro- and lævo-modifications of a synthetical tetralkylammonium base, and thus definitely established the existence of asymmetric optically active nitrogen compounds.

Since that time, by similar methods, he has obtained the dextrorotatory methyl ethyl thetine, a dextrorotatory tin compound, and both forms of a selenetine, thus demonstrating the fact that the elements nitrogen, sulphur, tin, and selenium are each capable, like carbon, of producing asymmetric combinations possessing optical activity. We therefore now possess direct experimental evidence in regard to the compounds of carbon, tin, sulphur, and selenium, as tetrad elements and of nitrogen as a pentad, so that it may confidently be expected that not only will the phosphorus series of elements be found capable of producing pairs of enantiomorphous compounds, but, possibly, similar modifications of oxonium bases may be discovered, and some of the metals, such as platinum, cobalt, and chromium, may be found to exhibit similar phenomena. The doctrine of valency, no less than the doctrine of atoms, in its application to all ordinary terrestrial chemical phenomena, is thus triumphantly established.

Professor Pope, it gives me great pleasure to be the medium of communicating to you the congratulations of the Council, and in handing you the Longstaff Medal I express the feelings of the whole chemical world when I say that we trust you will have health, and strength, and time to continue the researches which have already yielded such a rich harvest of splendid results.

Professor Pope, in expressing his sense of the honour done him by the award of the Longstaff Medal, desired to acknowledge gratefully the assistance which the Research Fund Committee had given to his work; it would be difficult to over-estimate the extent to which the Research Fund of the Chemical Society has contributed to the encouragement of chemical investigation in Great Britain. He wished also to record his indebtedness to his old friend and teacher,

Dr. H. E. Armstrong, who first taught him to look upon our science as a living and growing branch of knowledge, and inspired him with a desire to contribute something towards its development.

Dr. G. B. Longstaff, in expressing his great pleasure at being present on this occasion, said that the researches for which Professor Pope had been awarded the medal considerably advanced our conceptions of the atomic theory in so far as they broke down some of the apparent barriers between carbon and the other elements. He recalled the fact that his father, who had been a friend of Dalton's, was not only a Fellow of this Society from its commencement, but also the founder of Chemical Societies in Edinburgh and Glasgow, and was, moreover, instrumental in placing on a working basis the Research Fund (first suggested by Dr. Miller) to which Professor Pope had referred. Nevertheless, the name of the donor of the medal would have remained obscure except for the reflected light thrown on it, as it were, by the great names of an already long succession of eminent medallists.

A ballot for the election of Fellows was held and the following were subsequently declared duly elected:

Henry James Aubrey.
George Barger, B.A., B.Sc.
Colin Noel Bennett.
Wilfrid W. O. Beveridge.
Charles Drake Bibby.
Henry J. W. Brennand, B.A., M.B.
William Godsell Burghard.
Ernest Bury, M.Sc.
Thomas Campbell.
Albert James Carrier, B.Sc.
Edwin Jesse Fairhall.
William Hunter Gandy.
Francis Gerald Harmer.
Frank William George King.
Henry Wolff Levy.
John Howard Linday.
Charles Edwin L. Livesey, B.Sc.
John Christopher Mann.
Alfred Ernest Moore, B.A., B.Sc.
Arthur Moore.
George Marshall Norman, B.Sc.
George Harry Parry.
Charles Stanley Purcell.
Thomas Rhind, M.R.C.S.
Charles Joseph Smith.
James Cruickshank Smith, B.Sc.
Dennis Tyrrell.
Norbert Van Laer.
Sidney H. Woolhouse, M.A., B.Sc.

Of the following papers, those marked * were read:

*96. "The estimation of arsenic in fuel." By T. E. Thorpe.

An account was given of a method of estimating the amount of arsenic in fuels which is accurate, fairly rapid in execution, and which has the additional merit of directly distinguishing between the arsenic which is volatilised on burning the fuel and that which remains fixed in the ash. The process consists simply in burning a known quantity

of the finely powdered coke or coal in a stream of oxygen, passing the products of combustion through a suitable absorbing apparatus, and determining the amount of arsenic so absorbed as well as that left in the ash.

The estimation of the arsenic in the solutions may be made by means of the Marsh apparatus and comparison with standard deposits of arsenic, or preferably with the electrolytic method described in the subsequent communication. The accuracy of the method was tested by burning fuels containing known quantities of arsenic, added in the form of arsenical pyrites.

*97. "The electrolytic estimation of minute quantities of arsenic, more especially in brewing materials." By T. E. Thorpe.

An electrolytic method for detecting arsenic appears to have been first suggested by the late Professor Bloxam (*Quart. Journ. Chem. Soc.*, 1861, 13, 12 and 338), but in its original form it had several disadvantages which have prevented it from being generally adopted by chemists. The process has been carefully investigated in the Government Laboratory, and in the form described in the present communication it is easy of application, and is capable of giving trustworthy results with a comparatively small expenditure of time and trouble.

The test may be applied to malt and malt substitutes, wort, hops and hop substitutes, beer, yeast and yeast foods, finings, &c.

The advantages of the electrolytic method are:—

1. That it obviates the use of zinc.

2. It is simple in execution, is under perfect control, and may be carried out under such conditions that the results obtained by different operators are strictly comparable, inasmuch as with a current-strength of fair regularity the evolution of the gas is practically constant and uniform.

3. The whole of the solution to be tested for arsenic may be added to the apparatus at once, so that during the whole time of testing the arsenic is under the influence of the "nascent" hydrogen.

4. It has been established that such amounts of arsenic as are present in beer or its ingredients are evolved as hydrogen arsenide during the 30 minutes occupied by the test. The nature of the material associated with the arsenic is found to exercise no inhibiting effect on the formation and evolution of the hydrogen arsenide. Aqueous extracts of malts and worts may be added directly to the electrolytic apparatus without previous destruction of the organic matter as required by the zinc and acid process.

5. The deposits obtained are more uniform in character than those furnished by the zinc and acid method, and admit therefore of more accurate quantitative comparison.

6. The process allows of the simultaneous execution of a number of estimations of arsenic, depending upon the arrangement of the rheostat.

The disadvantages of the method are:—

1. The initial cost of the apparatus as compared with that employed in the zinc and acid method.

2. That it can only be applied when an electric current of sufficient intensity is available.

Discussion.

Dr. Thorne said the electrolytic process would prove of the greatest value to the large number of chemists who had to test for very small quantities of arsenic. The Marsh-Berzelius process was very reliable and accurate, and had been rightly recommended by the Committee of the Societies of Chemical Industry and Public Analysts, but those who used it knew the difficulty of obtaining zinc and hydrochloric acid free from arsenic, and hence these reagents must be carefully purified if the test was to be satisfactorily carried out. In the process just shown, these difficulties were obviated. He had had the opportunity of seeing the method in operation, and could therefore speak as to its satisfactory working.

Mr. Arthur R. Ling also thought that the electrolytic process would doubtless prove much more convenient than the Marsh-Berzelius method, which, in the case of many materials, necessitated the destruction of organic matter.

In the set of standards exhibited, the mirrors obtained in the presence of glucose appeared to be less intense than those produced in the absence of organic matter, from the same weight of arsenic, by the Marsh-Berzelius method.

Mr. William Thomson believed that the electrolytic method suggested by Lord Kelvin and the ingenious apparatus devised by Dr. Thorpe and his colleagues may ultimately afford the most practicable means of detecting arsenic in beer and food-stuffs.

He had tested one of the appliances, and had found that it would not detect the presence of more than about 1/350th of a grain of As_4O_6 per gallon, whilst the zinc and acid method easily detects 1/1000th of a grain per gallon when using 50 c.c. of the solution. Assuming at first that this difference was due to an insufficient surface of cathode, he used a much larger area of platinum wire gauze, but

obtained the same results with regard to the size of mirrors as those obtained in Dr. Thorpe's apparatus.

Platinum seems to retain minute quantities of arsenic, but when a pure zinc cathode is employed the 1/1000th part of a grain per gallon can easily be detected when using 50 c.c. of the solution.

He could confirm Dr. Thorpe's observations that minute quantities of arsenic in the form of pentoxide cannot be detected by the electrolytic method, 1/200th of a grain per gallon (using 50 c.c.) yielded no mirror at all with the platinum anode, and gave an approximately half-sized mirror with the zinc anode.

In other respects, his results differed from those obtained by Dr. Thorpe. He found that both amyl alcohol and sugar seriously reduced the size of the mirrors, and he was of opinion that it is unsatisfactory to test beer directly in Dr. Thorpe's apparatus.

Dr. McGowan said that, together with Mr. R. B. Floris, he had during the past year examined a large number of samples of anthracite for arsenic. The method which, after some preliminary experiments, they had employed in this work was a modification of Newlands and Ling's basic process. Although the results obtained were very consistent, and, as they believed, accurate, yet this process had the disadvantage of being an indirect method with regard to the "volatile" arsenic present. Other things being equal, a direct method such as that now brought forward by Dr. Thorpe was preferable.

Dr. Thorpe, in reply to Mr. Ling, stated that he had not been able to perceive any difference in the intensity of the mirrors produced from a known quantity of arsenic in the electrolytic method as compared with the Marsh-Berzelius method. A comparison of the standards in the two cases, as shown on the table, would prove that there was no practical difference in the two series.

In reference to what fell from Mr. Thomson, he might say that attempts had been made to increase the activity of the cathode by depositing platinum black upon it, but nothing seemed to be gained thereby. Experience showed that the best and most uniform results were obtained by keeping the metallic surfaces as clean and bright as possible.

***98. "Crystallised ammonium sulphate and the position of ammonium in the alkali series" By A. E. H. Tutton.**

The author has hitherto shown that the morphological and physical properties of the crystals of the normal sulphates and selenates of potassium, rubidium, and cæsium follow the order of progression of the atomic weights of the three alkali metals. An analogous study

of normal ammonium sulphate indicates that this salt stands in the series of normal alkali sulphates between rubidium and cæsium sulphates, and very close to the rubidium salt, as regards the following nine properties:—solubility, molecular volume, distance ratios (topic axes), refractive indices, axial ratios of the optical ellipsoid, molecular refraction along axial directions, mean refraction equivalent both for the crystallised and the dissolved salt, and the general optical scheme which governs the optic axial angle phenomena. With respect to all these properties, the replacement of the two atoms of potassium by the ten atoms composing the two NH_4 groups is accompanied by an effect but slightly greater than when two atoms of rubidium are substituted for those of potassium.

The specifically different nature of the ammonium radicle as compared with a metallic atom of the alkali group asserts itself in regard to the morphological angles and axial ratios, the specific refraction, certain details of the distance ratios and the optic axial angle phenomena, and in the development of only one instead of two cleavages. Yet even in the case of the crystallographical angles, this difference is only manifested with regard to the direction of the change of angle on replacement, and as far as the amount of change is concerned the ammonium compound stands between the rubidium and cæsium salts, and somewhat nearer to the latter. It is indeed, surprising that the introduction of eight additional atoms should be accompanied by less change in the exterior angles of the crystals than when an exchange of cæsium for potassium atoms occurs.

In short the specific constants indicate the peculiar nature of the ammonium radicle, whilst the molecular constants show that ammonium occupies a place in the alkali series immediately after rubidium.

This result opens up questions of the arrangement of the atoms in the molecule and the closeness of the packing of the molecular structural units in the crystal edifice. It suggests that either the atoms have a range of motion inside the molecular dimensions sufficiently wide to admit eight more atoms without altering those dimensions to an appreciably greater extent than when the transposition of rubidium and potassium atoms is effected, or that the structural units are so loosely packed, that is, the amount of free space is so large as compared with the amount of matter in the whole space defined by the distance ratios, that there is adequate room for the increase of the material part of the molecule by eight atoms, without separating the centres of contiguous molecules more than when a simple metallic interchange occurs.

*99. "The action of hydrogen on sodium." By A. Holt, jun.

Pieces of sodium free from oil were placed in a nickel boat and heated in a combustion tube through which a slow current of pure dry hydrogen was passing. An ordinary small combustion furnace without top tiles was employed, and it was arranged so that, whilst the lower part of the tube was strongly heated, the upper portion was kept at a lower temperature in order that the hydride might condense on it. The hydride thus obtained consisted of colourless matted crystals, a hairy deposit not unlike cotton wool, and a white powder deposited next to the glass. The hairy material was formed on and above the powder in front of the boat, whilst the crystals projected from the surface of the tube at either side of the boat.

The analysis was performed (i) by decomposing the hydride with dry, air-free hydrogen chloride, collecting the hydrogen due to the reaction and estimating the sodium chloride formed by titration with silver nitrate; (ii) by decomposing the hydride with absolute alcohol, collecting the hydrogen evolved, and estimating the sodium in the alcoholic solution by titration with standard acid. The ratio of sodium to hydrogen showed that the hydride had the composition NaH, as already stated by Moissan.

The hydride was instantly decomposed by water, forming sodium hydroxide and hydrogen, this result also occurring in air after a few minutes; it was at once decomposed by hydrochloric acid, the decomposition being accompanied by flame and a detonation. The hydride was immediately attacked by nitric and sulphuric acids, hydrogen sulphide, and alcohol, but ether, benzene, and mercury were without action on it.

With phenol and ammonia, it reacts only when heated, forming sodium phenoxide and sodamide respectively.

Carbon dioxide, when perfectly dry, has no action on the hydride at the ordinary temperature, but on heating, a reaction takes place with the formation of carbon and a carbonate. The partially dried gas reacts with the hydride at the ordinary temperature, yielding a formate and carbon. When heated with ferric oxide, the hydride gives a ferrate.

The combination of hydrogen with sodium appears to take place only when the latter is in a state of vapour; the sodium probably interacts only when it is partially monatomic.

100. "The action of halogens on compounds containing the carbonyl group." By Arthur Lapworth.

Although bromine acts very slowly on a dilute aqueous solution of acetone, yet, in presence of alkali, bromination occurs readily. It is now found that acids also accelerate the speed of substitution to an extent which depends mainly on the concentration of the hydrogen ions, although the nature of the anion appears to have some influence.

In the author's experiments, the concentration of the bromine was always considerably less than that corresponding with one molecular proportion, and at constant temperature the velocity with which the bromine disappeared was nearly independent of its concentration. With sulphuric acid between the concentrations 0·4*N* and 0·04*N*, the velocity increased somewhat less rapidly than the concentration of the acid, but slightly more rapidly than that of the acetone. The relative velocities of reaction with 0·4*N* sulphuric, nitric, and hydrochloric acids were about 1·19 : 1·20 : 1·36. The velocity was not affected if the acetone was left in contact with the dilute acid for several days before the introduction of the bromine.

Preliminary experiments with chlorine indicate that in presence of much acid it is removed at about the same speed as bromine.

These facts confirm the view that the bromination is not a process of direct substitution, but is preceded by a reversible change of the acetone, accelerated by acids or alkalis, to a second form, probably the enol, this modification being brominated nearly instantaneously. It has already been shown that in many cases acids promote the attainment of equilibrium between *ketonic* and *enolic* modifications (*Trans.*, 1902, 81, 1500, and *Proc.*, 1903, 19, 149).

The action of acids in accelerating substitution is not confined to aqueous solutions, but may be readily followed in other solvents.

The action of bromine and chlorine on other carbonyl compounds, as, for example, malonic ester and acetic anhydride, is greatly accelerated by acids. Even dry acetic acid is readily converted into its monobromo-derivative on the water-bath if it is first saturated with hydrogen chloride or bromide. The latter observation explains the action of a small quantity of phosphorus or phosphorus halogen compounds in promoting the action of chlorine and bromine on carboxylic acids, and the introduction of a suitable amount of the acid chloride appears equally effective when the acid contains water.

101. "Reactions involving the addition of hydrogen cyanide to carbon compounds." By A. Lapworth.

In order to ascertain the conditions under which hydrogen cyanide is most rapidly taken up by carbon compounds, camphorquinone was brought into contact with that substance in the presence of different agents which might possibly influence the reaction velocity, a rough measure of the latter being obtained by noting the speed with which the colour of the quinone disappeared.

The reaction, which was very slow in aqueous solution and was retarded by acids, was extremely rapid in presence of strong bases, and was accelerated by salts of weak acids. This result indicates that the change is effected by the cyanogen ions, a view confirmed by further experiments.

The great additive power of "nascent" hydrogen cyanide as compared with that of the agent in the free state is now readily understood, as the former occurs in presence of potassium cyanide.

When the addition product is fairly stable towards alkalis, it is not necessary actually to liberate the hydrogen cyanide. Camphorquinone may, in a few seconds, be largely converted into its cyanohydrin by shaking with a concentrated aqueous solution of potassium cyanide. Benzylidene benzylcyanide gives more than 30 per cent. of the theoretical amount of diphenylsuccinonitrile if warmed for 20 minutes in alcoholic solution with excess of potassium cyanide, although it does not appear to unite with hydrogen cyanide in the absence of its salts; phorone is rapidly converted into phorononitrile under the same conditions.

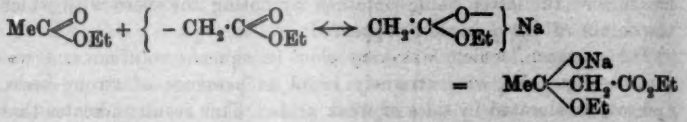
With potassium cyanide, benzaldehyde yields mandelonitrile. The latter compound condenses with the former in presence of bases to yield hydrogen cyanide and benzoin. The well-known benzoin condensation may therefore be represented as the result of the formation of the unstable cyanohydrin of benzoin by the ordinary addition process, $CHPh(OH)\cdot CN + PhCHO = OH\cdot CPh(CN)\cdot CHPh\cdot OH$, where the mandelonitrile behaves as the hydroxy-derivative of benzyl cyanide, a substance which is known to condense readily with benzaldehyde.

102. "The acetoacetic ester synthesis." By A. C. O. Hann and A. Lapworth.

Within the last four years convincing evidence has been accumulated to show that Claisen's hypothesis (*Annalen*, 1897, **297**, 92) as to the mechanism of the synthesis of β-ketonic esters and similar com-

pounds by the use of sodium or sodium ethoxide is incorrect, and, moreover, the facts which led to the formulation of this theory have been shown by Dieckmann (*Ber.*, 1900, **33**, 2677) to be capable of a far simpler explanation.

The authors' observations, which are being extended, confirm the view that the acetoacetic ester synthesis is essentially the result of an addition process in which a metallo-organic compound becomes attached to the carbonyl group of an ester



(compare Michael, *Ber.*, 1900, **33**, 3736; and Lapworth, *Trans.*, 1901, **79**, 1269).

Ethyl bromoacetate was allowed to react with certain esters in presence of zinc and magnesium; with ethyl oxalate, good yields of ethyl oxaloacetate were obtained; with ethyl acetate, the product was mainly ethyl γ-bromoacetoacetate, the latter compound being produced by an exactly similar process, excepting that the reaction occurs between two molecules of ethyl α-bromoacetate without the intervention of ethyl acetate. Fittig, Daimler, and Keller (*Annalen*, 1889, **249**, 184) employed this modification of the acetoacetic ester synthesis in preparing diethyl ketipate (diethyl oxalodiacetate), but the complete analogy between the two methods appears to have hitherto escaped notice.

103. "Rimu resin." By T. H. Easterfield and B. C. Aston.

Rimu (*Dacridium cupressinum*; natural order, *Coniferæ*) is one of the most valuable of the New Zealand timber trees, the cracks or shakes in the heart wood being nearly always partially or completely filled by a hard pink resin with a distinctly crystalline fracture.

The chief constituent (75 per cent.) of the resin, a crystalline acid, for which the name *rimuic acid* is proposed, melts at 192—193°, distils with very slight decomposition at 296—300° under 21 mm. pressure, and is optically active. It is easily soluble in alcohol or ether, and dissolves sparingly in water or light petroleum. Its formula, $C_{16}H_{20}O_2$, is supported by analysis, molecular weight determinations, titration values, and analysis of barium, lead, and silver salts. The barium compound is the most characteristic of the salts; it crystallises in well-defined, square plates having the composition $Ba(C_{16}H_{19}O_2)_2,14H_2O$. The alkali salts are very soluble and do not separate from solution in

the presence of excess of alkali. Rimuic acid is lævorotatory, having $[\alpha]_D - 159°$ in a 10 per cent. alcoholic solution; it yields benzoyl and acetyl derivatives, and its formula may be thus represented: $C_{15}H_{18}(OH)\cdot CO_2H$. Like most of the acids from the pine resins, it yields no esters when treated with alcohol and hydrochloric acid.

The acid yields two crystalline nitro-derivatives when nitrated in cold glacial acetic acid solution.

104. "Note on the karaka fruit." By T. H. Easterfield and B. C. Aston.

The kernel of the fruit of the Karaka tree (*Corynocarpus lævigata*; natural order, *Anacardiaceæ*), is a staple article of food amongst the Maoris and Morioris. In its raw state, it is bitter and very poisonous, but when baked and subsequently soaked in water its toxic properties disappear. Examination of the kernels shows that they contain 15 per cent. of a harmless, non-drying oil and that the aqueous extract of the nut contains mannite, mannose, and dextrose. When the extract is distilled, it yields a considerable quantity of prussic acid. From the aqueous extract, Skey obtained a bitter glucoside, karakin, which he stated, melted at 100° and contained no nitrogen; the authors find, however, that karakin is highly nitrogenous, and when pure melts at 122°. It is most readily obtained from an alcoholic extract of the kernel by removing the alcohol under diminished pressure and recrystallising the residue from warm water.

Karakin, which has the formula $C_{15}H_{24}O_{15}N_2$, crystallises in leaflets, and like amygdalin is only slightly toxic when removed from the enzymes with which it is associated. A second glucoside, *Corynocarpin*, can be obtained in small quantity by evaporating the aqueous extract at a temperature below 50° and extracting with ether. As this glucoside cannot be detected in the freshly prepared extract, and as the karakin disappears during the evaporation, it is probable that the second glucoside is a product of the partial hydrolysis of karakin. Corynocarpin crystallises in fine needles, melts at 140°, and is less soluble in hot alcohol than karakin.

105. "The slow oxidation of methane at low temperatures. II." By W. A. Bone and R. V. Wheeler.

The authors describe an apparatus for the closer investigation of slow combustion processes. This is essentially a closed system in which the reacting gaseous mixture can be circulated day and night

continuously, at a uniform rate, (1) over a heated surface the temperature of which is kept constant, and (2) through suitable washing and cooling vessels for the removal of soluble or condensable intermediate products. A specially devised manometer allows of pressure records being taken at regular intervals, so that the velocity of the oxidation may be measured.

Further experiments with this apparatus on the interaction of methane (2 volumes) and oxygen (1 volume) at 450° and 500°, whilst they entirely confirm the authors' previous conclusion that neither hydrogen nor carbon is liberated at any stage of the oxidation, and that the final products consist simply of carbon monoxide, carbon dioxide, and steam, have proved the transient formation of formaldehyde as an intermediate product. In one experiment, 13 per cent., and in another as much as 22 per cent., of the methane burnt was obtained as formaldehyde which had been rapidly removed from the sphere of action by passing the reacting mixture through cold water each time it left the tube containing the heated surface.

The authors conclude that the oxidation of methane involves the following stages:—

(1) The simultaneous formation of formaldehyde and steam, by the bimolecular reaction, $CH_4 + O_2 = CH_2O + H_2O$.

(2) The further oxidation of this formaldehyde to carbon monoxide, carbon dioxide, and steam. This is probably effected as the result of the simultaneous occurrence of the following reactions:—

(*a*) The bimolecular reaction, $CH_2O + O_2 = CO_2 + H_2O$.

(*b*) The trimolecular reaction, $2CH_2O + O_2 = 2CO + H_2O$.

106. "The alkylation of sugars." By T. Purdie and J. C. Irvine.

The method of alkylating hydroxyl groups by means of dry silver oxide and alkyl iodides does not appear directly applicable to aldoses or ketoses, and leads to oxidation and subsequent changes of some complexity; but α-methylglucoside and cane sugar can be methylated by means of this reaction. α-Methylglucoside, when methylated in methyl-alcoholic solution, yields a mixture of methyl glucose ethers; the main constituent, trimethyl α-methylglucoside, which can be isolated by fractional distillation, is a viscid syrup; it boils at 167—170° under 17 mm. pressure, exhibits dextrorotation, and has no action on Fehling's solution.

Complete methylation of trimethyl α-methylglucoside is readily effected with silver oxide in methyl iodide solution, and under these conditions, tetramethyl α-methylglucoside is obtained as a comparatively mobile liquid boiling at 144—145° under 17 mm. pressure; it

is dextrorotatory, and has no action on Fehling's solution. Tetramethyl glucose, which is produced by hydrolysing the tetramethylated glucoside with dilute hydrochloric acid, distils without decomposition at 182—185° under 20 mm. pressure, and solidifies slowly and crystallises from light petroleum in tufts of radiating needles, melting at 81—83°; it behaves like an aldose, reducing warm Fehling's solution, giving tetramethylgluconic acid on oxidation, and reacting with phenylhydrazine in molecular proportion to form an oil, which is apparently a hydrazone. Tetramethyl glucose is dextrorotatory, but does not exhibit any notable multirotation.

The production from α-methylglucoside of a tetramethylgluconic acid, capable of forming a lactone, proves conclusively that the oxygen of the ring in the formula of the alkylglucosides is coupled with the γ-, and not with the β-carbon atom.

A pentamethylated glucose, isomeric with the tetramethyl α-methylglucoside already mentioned, is produced when a solution of tetramethyl glucose in methyl iodide is treated with silver oxide; it boils at 124—127° under 8 mm. pressure, crystallises in slender prisms melting at 42—43°, and is lævorotatory.

Methylfructoside behaves like the corresponding glucoside, and, when completely methylated, yields tetramethyl methylfructoside; the two hydroxyl groups of acetone rhamnoside may also be methylated in a similar manner.

Cane sugar, on methylation, yields a neutral oil, which has no action on Fehling's solution until it is hydrolysed. The products of hydrolysis are the above-mentioned crystalline tetramethyl glucose and an uncrystallisable syrup, which is probably the corresponding methylated lævulose.

The fact that methylated cane sugar and methylated methylglucoside give on hydrolysis the same tetramethyl glucose proves that the constitution and linking of the glucose group of the disaccharide is the same as that of the simple glucoside, and affords conclusive evidence, at least so far as the glucose half of the molecule is concerned, of the correctness of Fischer's formula for cane sugar (*Ber.*, 1893, **26**, 2404).

107. "Trimethyl α-methylglucoside and trimethyl glucose." By T. Purdie and R. C. Bridgett.

When α-methylglucoside, in methyl-alcoholic solution, is methylated by means of dry silver oxide and methyl iodide, the chief product is trimethyl α-methylglucoside. In preparing this compound, it was found that, in addition to the lower methylated derivatives, the tetra-

methylated glucoside was also produced, but only in small quantity, even when a large excess of the alkylating agent was used. The last hydroxyl group to be methylated undergoes the change more slowly than the others, and it seems therefore probable that the unmethylated hydroxyl of the trimethyl α-methylglucoside is that of the terminal primary carbinol group of the glucoside. The difficulty encountered in completing the methylation is, however, largely due to the loss of alkylating material caused by the production of dimethyl ether. Special experiments showed that the action between silver oxide and methyl iodide is much more rapid in the presence of methyl alcohol, and that the production of dimethyl ether is probably due, not to the direct interaction of the oxide and iodide, but to the methylation of alcohol.

The specific rotation of the trimethyl α-methylglucoside, prepared by the authors was much in excess of that exhibited by the specimen referred to in the preceding note. The preparation of tetramethyl α-methylglucoside was also repeated, and the substance was found to be more dextrorotatory than the specimens previously examined. The discordant results may be due to intramolecular rearrangement occurring under the action of methyl iodide, resulting in the production of varying quantities of the corresponding stereoisomeric β-glucosides.

By hydrolysing trimethyl α-methylglucoside with dilute hydrochloric acid, trimethyl glucose was obtained as a viscid, colourless syrup, which distilled without appreciable decomposition at about 194° under 9 mm. pressure. The substance, which was dextrorotatory and had the properties of an aldose, reduced Fehling solution in the cold, and ammoniacal silver nitrate on slightly warming; it appeared to react with phenylhydrazine, but the product, which was an oil, could not be made to crystallise. On oxidation with bromine water, it yielded an oil boiling at about 160° under 11 mm. pressure. The numbers obtained by analysis, and from the estimation of methoxyl, agreed approximately with those required for trimethylgluconic lactone. The lactonic nature of the compound was confirmed by its behaviour on neutralisation, and by the gradual change of optical activity exhibited by its solution.

108. "Note on the corrosion of an Egyptian image." By Henry Bassett, jun.

An examination has been made of a bronze Egyptian image, about 6 inches high, and having a hollow base filled with lead. This figure probably dates from 200 to 100 B.C., and now bears a mutilated inscription which, according to Professor Flinders Petrie, reads as follows: "Khonsu give life to – – – – –, son of – – – – p, born of

Saaenhap." It was found in the delta of the Nile and is very extensively corroded, being covered by a thick, green coating, which in parts entirely replaces the original metal.

The material for analysis was obtained from the base of the figure, and the following analytical results were obtained:

Cu	50·65 per cent.	$CuCl_2$	29·34 per cent.
Pb	6·74 „	CuO	46·10 „
Sn	2·94 „	H_2O	11·07 „
Fe	0·15 „	SnO_2	3·73 „
Ni, Mn, &c.	0·11 „	PbO	7·26 „
Cl	15·71 „	Fe_2O_3	0·22 „
SiO_2 (as sand)	1·14 „	NiO, &c.....	0·14 „
H_2O	11·07 „	SiO_2	1·14 „
(NH_4)	0·11 „	NH_4Cl	0·32 „
	88·62		99·32

In the second table, the chlorine has been calculated as copper chloride, whilst the remaining copper and other metals are expressed as oxides.

Traces of calcium were also found, but the amount of sodium present was so small that it could only be detected by the flame test. If all the copper were present in the form of a basic chloride, $CuCl_2,3CuO,3H_2O$, corresponding with atacamite, this would require 26·84 per cent. $CuCl_2$, 47·57 per cent. CuO, and 10·78 per cent. H_2O. It will therefore be seen that the substance produced by corrosion is less basic than atacamite. The formation of this mineral during the corrosion of copper and bronze articles when buried in the soil has been shown by Berthelot to be very general (*Compt. rend.*, 1894, 118, 768), but although the formation of this basic copper chloride is in most cases due to the action of the sodium chloride in the soil (Berthelot, *loc. cit.*), yet in the present instance, ammonium chloride may have played the most important part, since the latter salt was found in amount sufficient for estimation, whereas the former was not.

109. "Contributions to the chemistry of the terpenes. Part I. The oxidation of pinene with chromyl chloride." By G. G. Henderson, T. Gray, and E. Smith.

When dissolved in carbon disulphide, chromyl chloride and pinene combine to form a solid compound, $C_{10}H_{16},2CrO_2Cl_2$, which is decomposed by water and yields a brown, oily liquid. This liquid, when distilled in steam, yields a quantity of resin and a volatile oil (Étard, *Compt. rend.*, 1893, 116, 434). The authors have found that the oil

contains a saturated *aldehyde*, $C_9H_{15}\cdot CHO$, an unsaturated *ketone*, $C_8H_{14}:CO$, and a small quantity of a chlorinated oxidation product of pinene. The aldehyde, which is a crystalline solid with a characteristic odour, melts at 32—33° and boils at 205—207° (under 755 mm. pressure); it is insoluble in water, but readily miscible with alcohol and ether. The *semicarbazone* crystallises in pearly leaflets and melts at 191°. The aldehyde rapidly undergoes spontaneous oxidation in the air, being converted into a saturated *acid*, $C_9H_{15}\cdot CO_2H$. This acid, which is obtained by oxidising the aldehyde with either boiling dilute nitric acid or aqueous potassium permanganate, crystallises in leaflets or flat prisms, and melts at 117°; it is only sparingly soluble in cold water, but very readily so in alcohol, and volatilises slowly in steam. The *lead* salt and the *silver* salt are obtained as white precipitates; both are soluble in boiling water, but the latter very sparingly.

The ketone is an almost colourless, aromatic liquid, which boils at 206—207° under 774 mm. pressure; its refractive index is 1·4760. The ketone at once decolorises permanganate, and combines additively with 1 mol. of bromine; it yields an oily *oxime* and a crystalline *semicarbazone*, which melts and decomposes at 226—228°; on oxidation with sodium hypobromite, it gives bromoform and *p*-toluic acid.

110. "Some physical and chemical properties of strong nitric acid." By V. H. Veley and J. J. Manley.

The investigations published by W. N. Hartley in the current number of the *Transactions* (p. 658) on the absorption spectra of nitric acid in various states of concentration have induced the authors to place on record certain physical and chemical properties of nitric acid varying in concentration from 78 to 100 per cent. HNO_3 in continuation of their former work (*Proc. Roy. Soc.*, 1901, **69**, 86, and *Phil. Mag.*, 1902, [vi], **3**, 118).

Although such properties as density, contraction, refractive indices, and electrical conductivity vary uniformly with percentage concentration from 78 to 92 per cent., yet from this point to 100 per cent. there is an exceptional alteration in the variation, reaching a maximum at about 96 per cent., this strength corresponding with an acid which, according to Hartley's view, might be indicated by the formula $3H_2N_2O_6,H_3NO_4$ (= 95·9 per cent. HNO_3).

Acid having this concentration appears to form a kind of eutectic solution, and therefore presents an analogous, although not strictly parallel case to that of sulphuric acid containing 98 per cent. H_2SO_4, which has been shown by R. Knietzsch (*Ber.*, 1901, **34**, 4069) to be a point of critical concentration as regards density, contraction (compare

Pickering, *Trans.*, 1890, 57, 74), electrical conductivity, chemical reactivity, vapour pressure, and, to a less degree, capillarity and viscosity.

As regards chemical properties, certain qualitative experiments have been made on the direct nitration of cotton by nitric acid of approximately 100 per cent. concentration without the addition of sulphuric acid.

111. "Notes on ozone." By J. K. H. Inglis.

Experiments have been made in order to ascertain the molecular state of ozone when dissolved in acids. In the first place, it was found that the amount of ozone present in an acid solution could be determined by means of the following reaction: $O_3 + 2HBr = Br_2 + O_2 + H_2O$, the bromine liberated being estimated by potassium iodide and sodium thiosulphate.

In the second place, an investigation of the solubility of ozone in water showed that the solution could not be brought into equilibrium with respect to the gas, since some of the latter was always decomposed on being bubbled through the solution, although the concentration of the latter remained constant. Hence, the molecular state cannot be ascertained by means of the solubility relationship.

Lastly, some experiments made on the action of ozone on hydrogen peroxide indicated that these substances acted slowly on one another, manganous sulphate behaving as a catalyser.

ERRATUM.

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Page	Line	
147	9*	*for* "ammonia," *read* "methylamine."

* From bottom.

Issued 14/11/03

PROCEEDINGS

OF THE

CHEMICAL SOCIETY.

Vol. 19. No. 270.

Extraordinary General Meeting, July 2nd, 1903. Professor TILDEN, F.R.S., President, in the chair.

The PRESIDENT stated that this meeting had been summoned to consider the following changes in the Bye-laws which had been proposed at one meeting of the Council, and considered and approved at a subsequent meeting.

It was proposed by the Treasurer, Dr. H. T. BROWN, and seconded by Professor THORPE,

"That Bye-law I., page 13, lines 3 and 4, be altered by *deleting* the words "one year."

The Bye-law at present reads:—

". . . .; and he shall "be entitled, so long as his annual subscription be not one "year in arrear, to one copy of the annual publications of the "Society. . . . ."

And that the Circulars in the Appendix be altered as follows:—

In Appendix, No. 2, "Letter notifying the Election of a Member," 5th and 6th lines, p. 26, *delete* the words "the Assistant Secretary." After the words "before admission,*" *add* the words "Payment should be made direct to the Society's Bankers ( ) either by Cheque or Post Office Order crossed a/c 'Chemical Society.' Your remittance should be accompanied by the enclosed Form with your Name and Address filled in."

In No. 3, "Annual Circular Letter of Treasurer," *delete* from "If paid" to end of circular, and *substitute* the same words as added in No. 2.

In No. 4, "Annual Circular Letter of the Treasurer to Fellows who are two years in arrear of their Subscriptions," *delete* from "Payments should be made" to end of circular, and *substitute* the same words as added in No. 2.

The motion having been submitted to the meeting was declared by the President to have been carried unanimously.

The following are abstracts of papers received during the vacation, and published or passed for publication in the *Transactions*.

112. "The composition of so-called elæomargaric acid." By T. Kametaka.

Maquenne having recently shown that the composition of Cloez's elæomargaric acid is more closely expressed by $C_{18}H_{30}O_2$ than by the formula $C_{17}H_{30}O_2$ adopted by Cloez, the author adduces evidence from his own work on the oil of *Elæococca vernicia* to show that the true formula for the acid is $C_{18}H_{32}O_2$. This proof depends on the formation of the bromine additive product, $C_{18}H_{32}O_2Br_4$, and on the result of the oxidation of the acid by permanganate, the product consisting of sativic acid, $C_{18}H_{32}(OH)_4O_2$, and a small amount of another hydroxy-acid, apparently dihydroxystearic acid. Titrations with standard caustic alkali and baryta solutions give, as a mean result, 280·5 for the molecular weight of elæomargaric acid, whilst $C_{18}H_{32}O_2$ requires 280.

113. "Phosphoric amidines." By R. M. Caven.

Phenyl-*p*-tolylphosphoric amidine, $C_6H_5NH{\cdot}PO{:}N{\cdot}C_6H_4CH_3$, which is formed as a by-product in preparing anilino-*p*-toluidinophosphoryl chloride (*Trans.*, 1902, **81**, 1369), is identical with a compound obtained in the preparation of *p*-toluidinoanilinophosphoryl chloride, and which should accordingly have the formula $C_6H_4(CH_3){\cdot}NH{\cdot}PO{:}N{\cdot}C_6H_5$. This identity is not to be attributed to the mobility of a hydrogen atom (compare von Pechmann, *Ber.*, 1895, **28**, 869 and 2362), but to the fact that the disubstituted phosphoryl chloride, in whichever way prepared, is one and the same substance, and that the derived amidine,

whether a single substance or a mixture, results from the withdrawal of hydrogen chloride by the action of the substituting base.

Diphenylphosphoric amidine, $C_6H_5NH{\cdot}PO{:}NC_6H_5$, and di-*p*-tolylphosphoric amidine were prepared from dianilino- and di-*p*-toluidinophosphoryl chlorides respectively.

The formation of such amidines from the diarylaminophosphoryl chlorides by the elimination of hydrogen chloride is facilitated by the agency of basic oxides such as those of silver, mercury, and magnesium.

114. "The mechanism of combustion." By H. E. Armstrong.

Assuming that chemical interchange and electrolysis are interchangeable equivalent terms, the author regards oxidation as an indirect process, inasmuch as the oxygen used is only indirectly incorporated with the oxidised matter; the oxidation takes place in a circuit composed of the oxidisable substance, conducting water and oxygen, the last of these acting as the depolariser. The results obtained by Bone and Wheeler are discussed in the light of this hypothesis. It is contended that in the case of methane, for example, oxygen is introduced atom by atom and that a substance such as carbon monoxide is a secondary product, not a direct product of oxidation nor of preferential oxidation of the carbon.

115. "The constituents of the volatile oil of the bark of *Cinnamomum pedatinervium* of Fiji." By E. Goulding.

The bark of *Cinnamomum pedatinervium*, a tree indigenous to Fiji, on distillation with steam, yields nearly 1 per cent. of a volatile oil which is almost colourless when first distilled, but gradually assumes a yellowish-brown colour. This oil has a sweet, aromatic odour, a pungent, spicy taste, sp. gr. 0·964 at 15°/15°, $[\alpha]_D$ −4·96° and n_D 1·4963. Its chief constituents are: (i) a *terpene*, $C_{10}H_{16}$, which has a sp. gr. 0·8659 at 15°/15°, $[\alpha]_D$ −17·72°, and yields an uncrystallisable *dibromide*, $C_{10}H_{16}Br_2$; (ii) linalool; (iii) safrole; (iv) eugenol; and probably (v) eugenol methyl ether. The quantitative composition of the oil is approximately as follows: terpene, 15—20 per cent.; alcohols, 30 per cent.; esters, 1·5 per cent.; safrole, 40—50 per cent.; eugenol, 1 per cent.; and 3 per cent. of eugenol methyl ether (?).

116. "Condensation of phenols with esters of unsaturated acids. Part VIII." By S. Ruhemann.

The compounds formed from α-naphthol and ethyl chlorofumarate must be formulated as derivatives of α-naphthaketocoumaran (compare

Trans., 1902, 81, 419), because although guaiacol reacts with ethyl chlorofumarate to yield only ethyl guaiacoloxyfumarate, yet its isomeride, the monomethyl ether of resorcinol, condenses with the ester to furnish ethyl *m*-methoxyphenoxyfumarate and an orange-coloured keto-coumaran derivative, which is called *dimethoxybisbenzaronyl*.

The latter derivative has properties similar to those recorded for bisnaphtharonyl; both compounds are reduced to colourless ketocoumaran derivatives by zinc dust and acetic acid, these reduction products being readily oxidised and converted into red substances.

Ethyl phenylpropiolate, when condensed with the monomethyl ether of resorcinol, yields ethyl *m*-methoxy-*β*-phenoxycinnamate, the free acid of which loses carbon dioxide on heating and furnishes *m*-methoxyphenoxystyrene.

The diethyl ether of phloroglucinol reacts with ethyl chlorofumarate to form ethyl diethoxyphenoxyfumarate, and with ethyl phenylpropiolate to yield ethyl diethoxyphenoxycinnamate.

117. "Action of phosphorus trichloride on the aromatic ethers of glycerol. Part II." By D. R. Boyd.

The study of the action of phosphorus trichloride on glycerol diaryl ethers has been extended (*Trans.*, 1901, 79, 1221), and the following substances have been prepared: *s-glycerol di-o-tolyl ether* (*β-hydroxy-αγ-di-o-tolyloxypropane*) boiling at 226° under 13 mm. pressure and melting at 36—37°; the corresponding meta-compound boiling at 232° (13 mm.); *bisdi-o-tolyloxyisopropyl phosphite* and its para-*isomeride*, which melt at 118—119° and 81—82° respectively; *di-o-* and *di-m-tolyloxyisopropylphosphorous acids* melting respectively at 88—89° and 85—87°, and certain of their metallic salts.

118. "Attempts to prepare isomeric quaternary salts." By M. Barrowcliff and F. S. Kipping.

In view of the probable existence of isomeric salts of the type $\frac{R_1}{R_1}>NR_2R_3R_4$ (*Trans.*, 1903, 83, 873), the authors have investigated some compounds of this class, including certain salts of the ethylpropylpiperidinium base already studied by Miss C. de Brereton Evans (*Trans.*, 1897, 71, 522); but although in all cases one of the radicles consisted of an optically active group, no indication whatever of the existence of isomerides has been observed.

Ethylpropylpiperidinium d-bromocamphorsulphonate,

$$C_5H_{10}NEtPr\cdot SO_3\cdot C_{10}H_{14}BrO,$$

crystallises in needles melting at 211°; it is very readily soluble in

water and chloroform, sparingly so in ethyl acetate, and insoluble in ether and light petroleum. *Benzylmethylpiperidinium* d-*bromocamphorsulphonate*, $C_5H_{10}NMeBz\cdot SO_3\cdot C_{10}H_{14}BrO$, melts at 160° when anhydrous and generally resembles the preceding compound. *Ethylpiperidine* d-*bromocamphorsulphonate*, $C_5H_{10}NEt,C_{10}H_{14}BrO\cdot SO_3H$, crystallises in needles melting at 158°.

These three salts, when repeatedly crystallised fractionally from various solvents under different conditions, did not yield dissimilar fractions. Molecular weight determinations made with ethylpropylpiperidinium iodide seem to show that whereas in aqueous solution the salt is ionically dissociated in a normal manner, yet in chloroform solution it is associated, possibly forming trimolecular complexes.

119. "Some salts of *d*- and *l*-α-phenylethylamines." By A. E. Hunter and F. S. Kipping.

The authors have investigated several salts of the *d*- and *l*-components of *dl*-phenylethylamine in the hope of obtaining isomerides corresponding with those derived from hydrindamine, but without success.

When the d-*bromocamphorsulphonate* of the *dl*-base is fractionally crystallised from water, it affords a salt which separates in prisms melting at 206—207°, and having in aqueous solution a molecular rotation identical with that of the *d*-bromo-acid, namely, $[M]_D + 271°$; this salt, however, is not partially racemic, as might be inferred from its optical properties, but is the compound of the *l*-base; the salt of the *d*-base was not isolated.

Although the ion of the *l*-base appears to be devoid of optical activity, the free base is distinctly lævorotatory in aqueous alcoholic solution, its specific rotation being about $[\alpha]_D - 25°$; this behaviour is similar to that of the *d*- and *l*-hydrindamines.

The *benzoyl* derivative, prepared from *l*-α-phenylethylamine by the Schotten-Baumann method, melts at 120°, is optically inactive, and seems to be identical with that of the *dl*-base.

l-α-*Phenylethylamine* d-*chlorocamphorsulphonate* melts at about 198° and has in aqueous solution a molecular rotation practically identical with that of the *d*-chloro-acid, namely, $[M]_D + 186°$.

l-α-*Phenylethylamine* d-*camphorsulphonate* melts at 149—150° and is practically indistinguishable by polarimetric examination from the corresponding salt of the *dl*-base, both substances having a molecular rotation approximating very closely to that of the acid; apparently the salt of the *dl*-base is not a definite partially racemic substance.

120. "β-Bromocinnamic acids." By J. J. Sudborough and K. J. Thompson.

Small amounts of β-bromo*allo*cinnamic acid (m. p. 159—160°) are obtained by the action of alkalis on cinnamic acid dibromide, but are not produced when the ethyl ester is used instead of the free acid dibromide.

In aqueous solution, the products of the combination of hydrogen bromide and phenylpropiolic acids consist entirely of β-bromo- and β-bromo*allo*-cinnamic acids; the relative amounts of the two isomerides being but slightly affected by light, temperature, or concentration of the solvent. The nature of the combination is materially affected by the medium in which the hydrogen bromide is dissolved; when acetic acid is used, more of the β-bromo-acid and less of the β-bromo*allo*-acid are obtained than when saturated aqueous solutions are employed. With benzene and carbon disulphide, the chief product is α-bromocinnamic acid.

Similar results have been met with in the combination of ethyl phenylpropiolate and hydrogen bromide.

Under the influence of alkalis, β-bromocinnamic acid and its esters lose hydrogen bromide much more readily than the β-bromo*allo*-acid and its esters.

Attempts have been made to prepare Michael's *iso*cinnamic acid in order to determine whether either the *allo*- or the *iso*-acid could be resolved into optically active constituents by the aid of active bases. The experiments made on the reduction of the β-bromo*allo*-acid indicate that the product, which consists of *allo*cinnamic acid with a trace of ordinary cinnamic acid, does not contain the *iso*-acid.

121. "Vapour pressure of aqueous ammonia solution. Part II." By E. P. Perman.

The partial pressures of the ammonia and water-vapour evolved by an aqueous ammonia solution have been found by aspirating a known volume of air through the solution and estimating the amounts of ammonia and water withdrawn. The experiments were made at temperatures ranging from 0° to 60°, and the concentration of the solutions employed varied from 0 to 22·5 per cent. of ammonia.

It was found that the sum of the partial pressures was equal to the total pressure determined by the statical method, and also that the relationship between the partial pressures and the concentration of the solution is that deduced by Duhem and others for binary mixtures of liquids.

122. "Isomeric aminoamidines of the naphthalene series. (Fourth communication on anhydro-bases.)" By R. Meldola, J. V. Eyre, and J. H. Lane.

The authors have succeeded in isolating the free base, ethenyltriaminonaphthalene, obtained by the reduction of dinitro-α-acetonaphthalide by tin and hydrochloric acid. The compound is characterised by its tendency to form complex hydrates containing $9\frac{1}{2}$, $3\frac{1}{2}$ or $1\frac{1}{2}$ mols. of water. The *acetate*, $C_{12}H_{11}N_3,C_2H_4O_2,H_2O$, *oxalate*, $C_{12}H_{11}N_3,C_2H_2O_4,2H_2O$, and *mercurichloride*,

$$C_{12}H_{11}N_3,HCl,HgCl_2,1\tfrac{1}{2}H_2O,$$

have been prepared.

The *N*-ethyl derivative of the acetyl derivative having the formula $C_{16}H_{17}ON_3,\frac{1}{2}H_2O$ has been obtained, and characterised by the formation of its *picrate*, $C_{16}H_{17}ON_3,C_6H_2(NO_2)_3OH,H_2O$, and *aurichloride*, $C_{16}H_{17}ON_3,HAuCl_4,2H_2O$.

By eliminating the NH_2 group in the ethenyltriaminonaphthalene by the diazo-method, an ethenyldiaminonaphthalene (methylnaphthimidazole) has been obtained, which differs from the only compound of this formula at present known (Prager, *Ber.*, 1885, 18, 2161). The isomerism of the aminoamidines has thus been proved to extend to the parent compounds, so that the cause of the isomerism is to be sought in the structure of the amidine ring. The following salts and derivatives have been prepared: *hydrochloride*, $C_{12}H_{10}N_2,HCl,H_2O$, *chromate*, $C_{12}H_{10}N_2,H_2CrO_4,2H_2O$, and *picrate*.

The base itself has the formula $C_{12}H_{10}N_2,H_2O$, and the water could not be expelled without decomposing the compound. The amidine ring apparently breaks down by the action of benzoyl chloride in presence of alkali with the formation of dibenzoyl-*o*-naphthylenediamine. The N-*methyl* derivative, an oily base, has a crystalline *picrate* $C_{13}H_{12}N_2,C_6H_2(NO_2)_3OH$. The crystalline N-*ethyl* derivative, $C_{14}H_{14}N_2$ is anhydrous and yields the following crystalline salts: *chromate*, $C_{14}H_{14}N_2,H_2CrO_4$, and *picrate*, $C_{14}H_{14}N_2,C_6H_2(NO_2)_3OH,H_2O$; its *aurichloride* contains $2H_2O$ and, when heated in the water-oven, becomes converted into the monohydrate. The *platinichloride* also yields hydrates containing 4, 2, and 1 mols. of water.

The *N*-ethyl derivative of the known ethenyldiaminonaphthalene (compare Otto Fischer, *Ber.*, 1901, 34, 935) prepared for comparison with its isomeride, is found to be resinous, but the *chromate*, *picrate*, *platinichloride*, and *aurichloride* are well characterised.

The ethenyltriaminonaphthalene, obtained by the reduction of dinitro-α-acetonaphthalide by iron and hydrochloric acid (Markfeldt's base) yields a crystalline *oxalate* with $4H_2O$ and a *mercurichloride*,

$C_{13}H_{11}N_3,2HCl,HgCl_2,5H_2O$. Its benzoyl derivative has now been prepared by the Schotten-Baumann method (compare *Trans.*, 1900, 77, 1165).

Ethenyltriaminonaphthalene (Meldola and Streatfeild's base) is converted into its isomeride (Markfeldt's) by further reduction with iron and hydrochloric acid, but reduction with sodium amalgam in the presence of acetic acid does not bring about this transformation. Reduction of dinitro-α-acetonaphthalide with zinc and hydrochloric acid gives the original (M. and S.) base.

123. "Polythiosulphonic acids of *p*-diamines." By A. G. Green and A. G. Perkin.

The series of polythiosulphonic acids of *p*-diamines formerly prepared by one of the authors in collaboration with A. Meyenberg (compare Eng. Pat. Specifications, Nos. 21832, [98]; 22460, [98]; 22847, [98]; 5039, [99]; 18658, [99]; and 4792, [00]) are well-crystallised compounds which, when oxidised together with primary amines and diamines, give rise to a series of black colouring matters possessing the characteristic properties of "sulphide" colours. The present communication deals with the further characterisation of these polythiosulphonic acids, especially of the di- and tetra-thiosulphonic acids of *p*-phenylenediamine, $C_6H_2(NH_2)_2(S{\cdot}SO_3H)_2$ and $C_6(NH_2)_2(S{\cdot}SO_3H)_4$, which are obtained by the oxidation of *p*-phenylenediamine in the presence of sodium thiosulphate, using 2 or 4 molecular proportions of the latter with a corresponding quantity of the oxidising agent.

Owing to the presence of the S_2O_3H groups in ortho-positions with respect to the amino-radicles, the *p*-phenylenediaminedithiosulphonic acid exhibits several characteristic condensations. Thus, with nitrous acid it gives a stable bisdiazosulphide, $C_6H_2\left(<\begin{matrix}N_2\\S\end{matrix}\right)_2$; with organic anhydrides or with aldehydes, it gives anhydro-compounds.

On boiling the di- or tetra-thiosulphonic acid with aqueous acids, sulphurous and sulphuric acids are eliminated, and yellow or red salts of sulphide bases are obtained. These bases, which appear to have the constitution $C_6H_2(NH_2)_2<\begin{matrix}S\\S\end{matrix}$ and $\begin{matrix}S\\S\end{matrix}>C_6(NH_2)_2<\begin{matrix}S\\S\end{matrix}$, are of dark colour, insoluble in water and other solvents, but dissolving in an aqueous solution of sodium sulphide, in which respect they resemble the "sulphide" colours; they are reconverted into the respective polythiosulphonic acids by prolonged treatment with sulphurous acid in the presence of air.

When treated with zinc dust, the dithiosulphonic acid is reduced to the disulphydride $C_6H_2(NH_2)_2(SH)_2$.

124. "The rotation of the menthyl esters of the isomeric chlorobenzoic acids." By J. B. Cohen and S. H. C. Briggs.

The authors have prepared the menthyl esters of the mono- and di-chlorobenzoic acids, and have compared their specific and molecular rotations.

The following represents the order of optical activity, beginning with the least active: 2:6; 2:3; ortho; 2:5; 2:4; 3:4; 3:5; unsubstituted; meta; para. These results lead to the following conclusions: (1) the greatest effect (decrease) in the rotation of the unsubstituted menthyl ester is produced when the halogen enters the ortho-position with respect to the carboxyl group; the least, when the halogen is in the meta- and para-positions, which, singly, slightly increase the rotation. (2) The monohalogen derivatives accord with the rule laid down by Frankland and Wharton (*Trans.*, 1896, **69**, 1320, 1583), and confirmed by Guye and Babel (*Abstr.*, 1899, ii, 719) and Tschugaeff (*Abstr.*, 1903, ii, 2), and follow the order: ortho, unsubstituted, meta, para.

(3) Two halogens attached to adjoining carbon atoms (2:3 and 3:4) produce a greater effect than either singly.

It might be expected that the rotations of the 2:3- and 2:5-esters would be approximately the same, inasmuch as the chlorine atoms in both isomerides occupy the ortho- and meta-positions with respect to the carboxyl group, but in reality the rotation of the 2:3-ester is much lower, and that of the 2:5-isomeride slightly higher than the value obtained for the ortho-compound.

The low rotation of the 3:4- and 3:5-esters does not support the theory of the lever-arm (Frankland and Wharton, *loc. cit.*).

125. "The reaction between phosphorus and oxygen. Part I." By E. J. Russell.

A small quantity of water is necessary for the oxidation of phosphorus, and the reaction proceeds most rapidly when that amount is present which is left after drying with sulphuric acid. In the presence of much water vapour, action is considerably retarded. The formation of ozone and hydrogen peroxide requires the presence of excess of water; these bodies are not direct products of the reaction between phosphorus and oxygen.

Moderately dried phosphorus and oxygen react under all the pressures employed, and the phenomena of false equilibrium are not seen. The reaction may be divided into two stages: in the first, oxidation is slow and accompanied by a very feeble glow, the action being

apparently unimolecular; the oxide formed is still under investigation. The second stage begins when the pressure falls below about 500 mm.; oxidation is continuously accelerated until all the oxygen is absorbed. The luminosity is very marked, and phosphorus pentoxide is formed. No simple expression could be found connecting the velocity of oxidation with the pressure of oxygen.

When an inert gas, such as nitrogen, is present, the phenomena are substantially the same, but the acceleration of the second period ceases after a time and a retardation sets in. This variation is, however, explained on a purely mechanical hypothesis.

When phosphorus oxidises in moist oxygen, the reaction differs from that taking place in dry oxygen in the following respects:

(*a*). It does not begin until the pressure of oxygen is less than about 500 mm.; when it does take place it is slower, and is much retarded during the earlier part of the reaction. The retardation is explained as being due to a protective film formed by the water on the phosphorus.

(*b*). Ozone and hydrogen peroxide are produced, and, in presence of nitrogen, these substances are accompanied by ammonium nitrite and nitrate. None of the theories at present held completely accounts for these observations.

If smaller quantities of water are present (4 or 5 mm. pressure instead of 16 or 20 mm.), the velocity curve does not differ greatly from that obtained in the absence of water. And the difference observed when the higher quantity of water is present can readily be explained as being due to the protective layer of this liquid. There is no reason to suppose that the primary reaction between the phosphorus and oxygen differs in the two cases.

126. "Action of hydrogen peroxide on carbohydrates in the presence of ferrous sulphate. IV." By R. S. Morrell and J. M. Crofts.

The substances formed by adding hydrogen peroxide solutions of arabinose and rhamnose in the presence of ferrous sulphate yielded osazones with phenylhydrazine acetate, and it was therefore considered that arabinose and rhamnose had been oxidised to the corresponding osones (*Trans.*, 1899, **75**, 786, and 1900, **77**, 1219). Aqueous solutions of these two osones have been found to react at the ordinary temperature with *p*-bromophenylhydrazine, giving rise to osazones. The action of larger quantities of hydrogen peroxide on glucose and fructose has been investigated, and the metallic salts of glyoxylic, glycollic, and trihydroxybutyric acids have been obtained. The formation of glycollic acid from glucose is peculiar, and is not easily accounted for on the assumption that the sugar molecule is transformed into an osone before a disruption of the carbon chain takes place.

127. "Ethyl benzylideneanilineacetoacetate." By R. S. Morrell and A. E. Bellars.

The authors find that the action of benzylideneaniline on ethyl acetoacetate gives rise to ethyl benzylideneanilineacetoacetate, which melts between 78° and 80° after recrystallisation from benzene and carbon tetrachloride. The addition of piperidine or minute quantities of sodium ethoxide does not cause any change in the melting point of the recrystallised addition product (compare Schiff, *Ber.*, 1898, **31**, 207; Rabe, *ibid.*, 1902, **35**, 3950; Francis, *ibid.*, 1902, **35**, 3949), but the solvents used in the recrystallisation must be pure, otherwise it is impossible to obtain the ethyl benzylideneanilineacetoacetate with a constant melting point. The addition of small quantities of sodium ethoxide to a mixture of benzylideneaniline and ethyl acetoacetate causes the formation of a mixture of β_1- and β_2-forms of ethyl benzylidenediacetoacetate (Rabe, *Annalen*, 1900, 313, 176). The molecular weight of the ethyl benzylideneanilineacetoacetate in benzene or carbon tetrachloride solution decreases as the solution becomes more dilute, and also on heating or when it is kept for some time.

128. "Studies on enzyme action. I. The correlation of the stereoisomeric α- and β-glucosides with the corresponding glucoses." By E. F. Armstrong.

The stereoisomeric α- and β-alkyl glucoses have been converted, by means of enzymes, into the corresponding glucosides. It is thus shown that glucose has a lactonic structure, and consists, in solution, of a mixture of two stereoisomeric lactones. The changes in rotatory power which dissolved glucose undergoes involves the passage of one or other form of the lactone into a mixture of the two.

129. "A dynamical study of the Friedel-Crafts reaction." By B. D. Steele.

In order to determine, if possible, the mechanism of the Friedel-Crafts reaction, the synthesis of phenyl tolyl ketone from toluene and benzoyl chloride in presence of aluminium or ferric chloride, and that of phenyltolylmethane from toluene and benzyl chloride in presence of the same condensing agents have been studied dynamically.

The course of the reaction in each case was followed by passing a rapid

current of hydrogen through the reaction mixture, and titrating the hydrochloric acid thus carried over.

The following conclusions have been deduced:

(1) In the synthesis of a ketone from a hydrocarbon and an acid chloride in the presence of aluminium chloride, the explanation suggested by Perrier (*Ber.*, 1900, 33, 815) and by Boeseken (*Rec. trav. chim.*, 1900, 19, 19; 1901, 20, 102) seems to be quite justifiable, providing that the aluminium chloride is not present in excess.

(2) In the presence of an excess of the condensing agents, the reaction, instead of being unimolecular, becomes bimolecular, and is best explained by assuming that the reagents are two intermediate compounds, each containing aluminium chloride.

(3) In the presence of ferric chloride, the reaction is also bimolecular, and is best explained on the foregoing assumption.

(4) The synthesis of phenyltolylmethane from toluene and benzyl chloride, in the presence of either aluminium or ferric chloride, is a unimolecular reaction, due to the interaction of the toluene and a compound of the organic and metallic chlorides.

Thursday, November 5th, 1903. Professor W. A. Tilden, D.Sc., F.R.S., President, in the Chair.

Messrs C. N. Bennett, G. Barger, H. Gough, W. Mann, C. D. Bibby, and S. H. Woodhouse were formally admitted Fellows of the Society.

Certificates were read for the first time in favour of Messrs:

Robert Duncombe Abell, Ph.D., D.Sc., Sandbach, Cheshire.
Percy Appleyard, Albany, Western Australia.
Edward F. Armstong, Ph.D., 55, Granville Park, Lewisham, S.E.
Herbert Henry Ashdown, 3, Genesta Road, Plumstead.
Herbert Moore Attwell, Limpley Stoke, Bath.
William C. Badcock, B.A., The Grammar School, Crediton, Devon.
Harold J. Bailey, 40, The Avenue, Pontypridd, South Wales.
Thomas Vipond Barker, Exeter College, Oxford.
Charles Marsh Beadnell, H.M.S. Barracouta, Capetown.
William Beam, M.A., M.D., Pension Sima, Cairo, Egypt.
Harold Goodenough Bayly, "Moatside," Bedford.
Henry James Wheeler Bliss, Balliol College, Oxford.

Nicholas John Bluman, 10, Amersham Road, New Cross, S.E.
Paul Brühl, Engineering College, Sibpur, near Calcutta.
Erasmus Robert Buggé, 327, Grove Green Road, Leytonstone.
William Clacher, Bryantwood, Auckland Road, Ilford.
William Thomas Deeks, High Street, Shanklin, I.W.
Henry Russell Ellis, 177, Warwick Road, W.
Charles E. Fawsitt, Ph.D., B.Sc., 9, Foremount Terrace, Glasgow.
John A. N. Friend, M.Sc., 2, Francis Road, Watford, Herts.
Ernest A. Gardiner, B.A., Bretherton, near Preston, Lancs.
Frank B. Gatehouse, 56, Windmill Street, Gravesend, Kent.
Frank B. Grundy, Red Lodge, King's Road, Richmond, S.W.
John T. Hall, West View, Stanwell, Staines.
Harold M. Heasman, 1, Carlisle Road, Finsbury Park, N.
Arthur V. Hendrickson, Gas Works, Lower Sydenham, S.E.
John G. Howarth, "Danes Dyke," Capstone Road, Bournemouth.
Herbert Hymans, 13, Trinity Square, E.C.
Edward Charles Ibbotson, 3, Ashgate Road, Sheffield.
William H. Jackson, 73, Church Street, West Hartlepool.
Thomas Oliver Kent, 89, Loughboro' Park, Brixton, S.W.
John J. Kielty, 71, Cairo Road, Walthamstow.
Harley F. Knight, 64, Amhurst Park, Stamford Hill, N.
John Laing, Everlie, Skelmorlie, N.B.
Francis E. E. Lamplough, B.A., Trinity College, Cambridge.
Harold Duff Leadbetter, 95, Capel Road, Forest Gate, E.
Gervaise Le Bas, B.Sc., Baymont House, St. Aubins, Jersey.
David B. Macdonald, 18, Kimberley Road, Leicester.
Frederick W. McMahon, 61, Brockley Rise, Forest Hill, S.E.
Ernest W. Mann, Willow Avenue, Edgbaston, Birmingham.
Gordon W. Monier-Williams, B.A., The Lammas, Esher, Surrey.
Urban O. S. Nairne, 7, Hawthorne Terrace, Barking, Essex.
James Victor Nevin, Bristol Dispensary, Bristol.
Henry George Pike, Downton, Salisbury, Wilts.
George Horace G. Plymen, 2, Melton Road, Leicester.
William Branch Pollard, B.A., 68, Finnart Street, Greenock, N.B.
Stiles W. G. Rich, Stanley Street, South Brisbane, Queensland.
Harold E. Richardson, B.A., B.Sc., 63, Lansdowne Road, Ilford.
William David Rogers, 36, Grange Road, Smethwick.
George Senter, Ph.D., B.Sc., 37, Ronalds Road, Highbury, N.
Arthur Slator, Ph.D., M.Sc., The Priory, Burton-on-Trent.
William V. Smith, B.A., 7, Grove Road, Ipswich Road, Norwich.
A. W. Stewart, B.Sc., 18, Annfield Terrace, Partick Hill, Glasgow.
Arthur Tighe, 20, Marlborough Place, St. John's Wood, N.W.
Arnold Turner, 316, Entwisle Road, Rochdale.
William E. S. Turner, B.Sc., 52, Cheshire Road, Smethwick.

Miles Walker-Pole, Braamfontein, Johannesburg.
Carl F. R. Weiss, Ph.D., M.A., Victoria Park, Manchester.
Fred Wright, Terry Street, Balmain, N.S.W.

Certificates in favour of the following were authorised by the Council for presentation for ballot under Bye-law I. (3):

Thein Kin, Rangoon, Burma.
Mata Prasad, Benares, India.
P. W. Robertson, Wellington, New Zealand.

The PRESIDENT announced that the Council had decided that a supplementary number of the Transactions should be issued on December 31st, and that after that date the Journal would be issued on the last day of each month instead of the first day of the month as hitherto, the first number for 1904 being issued on January 31st.

The PRESIDENT then reminded the Society of the announcement he had been permitted to make at the meeting on May 20th in reference to the bust of Dalton which was now before them, and read the following letter from Professor Thorpe.

GOVERNMENT LABORATORY,
LONDON, W.C.

October, 1903.

DEAR MR. PRESIDENT,

Although the walls of the Society's apartments are adorned with busts, medallions and other mementoes of eminent chemists, there is among them no memorial of one of the most illustrious of all chemists—John Dalton.

As a fellow-townsman of Dalton, may I be permitted, in grateful remembrance of the fact that my early education was promoted by a studentship founded in his memory and associated with his name, to supply, in some small measure, the lack of such a memorial, and to ask that the Council will do me the honour to accept the bronze bust which accompanies this letter?

As you are aware, this month one hundred years ago saw the promulgation of Dalton's great generalisation. There is, therefore, I venture to hope, a special fitness in preferring my request at this particular time.

The bronze is the work of Miss Levick, who is already favourably known to the Society by her reproduction of the bust of Davy in their possession. Of the artistic merits of her present work others must be the judge, but I may be permitted here to express my indebtedness to

her for the skill and conscientious care with which she has striven to make a faithful and adequate presentment of the grand old philosopher. She has been greatly assisted by the kindness and co-operation of many friends to whom my acknowledgments are due. Practically all the available material has been placed at her disposal—the copy of the well-known Chantrey bust in the possession of the Literary and Philosophical Society of Manchester; the Cardwell bust belonging to Owens College; a beautiful but little known steel engraving by Stephenson, given to me by my friend Dr. Blackley; the portrait in the possession of the Royal Society; the precious daguerreotype formerly in the possession of Dalton's friend and pupil the late Mr. John Dale, and now the property of the Society; together with a number of other drawings and engravings.

I am gratified to know that those who are competent to form an opinion have expressed the conviction that Miss Levick has made admirable use of her ample material, and that she has succeeded not only in reproducing the lineaments of the great chemist, but in infusing into them a conception of the simplicity, dignity and grandeur of his character.

I am, Dear Mr. President,

Faithfully yours,

T. E. THORPE.

The Council had that afternoon passed a resolution tendering to Dr. Thorpe an expression of most cordial thanks for his generous and interesting gift.

Of the following papers, those marked * were read:

*130. "The reduction of hydrazoic acid." By W. T. Cooke.

Apart from Peratoner and Oddo's observation (*Gazzetta*, 1895, **25**, 2) that ammonia is formed at the cathode when hydrazoic acid is electrolysed, the behaviour of hydrazoic acid when subjected to reducing agents does not appear to have been studied.

Considering the acid as a cyclic compound having the formula $NH<\begin{smallmatrix}N\\|\\N\end{smallmatrix}$, the first step in its reduction should lead to the formation of the hydride, $NH<\begin{smallmatrix}NH\\|\\NH\end{smallmatrix}$, but the existence of this hypothetical compound seems doubtful in view of the ease with which nitrogen hydrides pass into ammonia. On the other hand, boron, which has even less affinity

for hydrogen than nitrogen, forms the corresponding hydride, B_2H_2 (Ramsay and Hatfield, *Proc.*, 1901, 17, 152), so that N_2H_2 may possibly exist as a gas with feebly basic properties. Further reduction would, however, result in a breaking up of the ring, with the formation of ammonia, and possibly hydrazine, as an intermediate product. These substances were actually obtained when the following reducing agents were tried: sodium amalgam, zinc and either hydrochloric or sulphuric acid, sodium polysulphide, and ferrous hydroxide.

Ammonia was the chief product, and the hydrazine, which was generally present in small quantities, was obtained in appreciable amount only in those experiments where it was removed from solution in the form of an insoluble compound during the reaction. It may, however, be formed at first in accordance with the equation $NH{\cdot}N_2 + 3H_2 = NH_3 + N_2H_4$, and then at once reduced, for trial reduction experiments, in which hydrazine sulphate was used instead of hydrazoic acid, showed that some ammonia was formed.

The hydrazoic acid was made by the method devised by Wislicenus (*Ber.*, 1892, 25, 2084), and was employed in approximately decinormal solution.

The products of reduction were separated from the mixture by distillation from an alkaline solution, the distilling flask being provided with a "Kjeldahl" bulb; in most cases, the distillates, when acidified with hydrochloric acid and concentrated, showed a slight reducing action towards ammoniacal silver nitrate, Fehling's solution, &c.; the residues in the distilling flasks also produced the same effect. This result might be anticipated since hydrazine hydrate is less volatile in steam than ammonia. The latter substance was recognised by its odour, alkalinity, reaction with Nessler's reagent, and the analyses of its platinichloride.

In reducing with sodium amalgam, the solid reagent was slowly added to separate quantities each consisting of 50 to 100 c.c. of acid, so as to maintain a slight effervescence. After about a week, the liquid was decanted from the mercury and distilled. Reduction proceeded more quickly in acid solution, but the hydrazoic acid was easily lost.

The addition of sodium amalgam to freshly precipitated silver hydrazoate, which had been carefully washed until free from acid, and suspended in water, caused the separation of silver, which partly went into solution in the colloidal condition, giving the liquid a dark brown colour.

The hydrazoic acid readily attacked zinc, and when the effervescence had subsided, sulphuric, or occasionally hydrochloric, acid was gradually added in small quantities. In the case of sulphuric acid, a granular deposit of the double salt, $(N_2H_4)_2H_2SO_4.ZnSO_4$ (*Ber.*, 1893, 26, 410), was formed on allowing the reaction to continue for at least a week.

A solution of this salt, which is fairly soluble in hot water, easily reduces an acid solution of gold chloride. The precipitate of cadmium sulphide obtained on mixing solutions of cadmium hydrazoate and sodium polysulphide was collected after a few days, when the filtrate was found to contain a small quantity of ammonia.

An alkaline solution of sodium hydrazoate was used in the case of ferrous hydroxide, and the reduction was carried on at the boiling temperature in a current of hydrogen, the ammonia evolved being collected in dilute acid. The mixture in the flask was distilled while still alkaline, and again when acidified with sulphuric acid, the latter operation being performed in order to recover the unused hydrazoic acid.

Similar experiments were also made on the reduction of hydrazine sulphate with zinc or sodium amalgam; in both instances, a small amount of ammonia was formed. In the case of zinc and sulphuric acid, the formation of an appreciable amount of hydrogen sulphide was noticed at the beginning of the reduction.

These results show that it is possible by the use of reducing agents to split the hydrazoic ring, and that there is certainly no tendency for the ring to become saturated by the addition of two atoms of hydrogen.

*131. "Preliminary note on the viscosity of liquid mixtures." By A. E. Dunstan and W. H. C. Jemmett.

Three typical liquid mixtures have been used in this research, namely: (1) ethyl acetate and benzene; (2) benzene and ethyl alcohol; (3) ethyl alcohol and water.

The apparatus used was of Ostwald's pattern; the viscometer was immersed in a bath, which was kept at 25° by means of a thermostat, and was stirred by a current of carbon dioxide.

In the first mixture, which consisted of a pair of non-associative unimolecular liquids, the viscosity was an additive property, and an almost straight line curve was obtained having a slight concavity. Neither liquid has much effect on the other; the concavity probably indicates slight association.

A similar result was also obtained in the case of a mixture of benzene and carbon disulphide.

In the second mixture, where only the alcohol was associative, a minimum point was reached when about 6 per cent. of alcohol was present; the remaining part of the curve was normal. This minimum point is probably due to further association of alcohol molecules. It has been shown in freezing point determinations that alcohol in benzene gives abnormally high results, and Pickering has recognised a

break in the freezing point curve corresponding with 6 per cent. of alcohol.

In the third case, both liquids are associative, and as the percentage of either constituent increased, there was a strongly marked rise of viscosity, which culminated in a maximum point, corresponding with 55·83 per cent. of alcohol. At this point, the proportion of alcohol and water is very approximately 2 mols. water to 1 mol. alcohol. I. Traube (*Ber.*, 1886, 19, 871) indicates maxima of a similar nature for this mixture at about 46—50 per cent. alcohol. Pickering has shown that in the freezing point curve of alcohol in water there is a break at 53 per cent. (Trans., 1893, 63, 1012).

In the case of the third mixture, each substance possibly dissociates the associated molecules of the other, thus giving rise to an increased number of active particles. Jones and Murray (*Amer. Chem. J.*, 1903, 30, 193) have shown that such dissociation is the case for several associative bodies. This would explain the gradually increasing viscosity up to the maximum point corresponding with $2H_2O—C_2H_5OH$.

The work is being extended to other liquid mixtures.

***132. "A contribution to the study of the reactions of hydrogen peroxide." By J. McLachlan.**

When solutions of hydrogen peroxide and potassium bichromate are mixed and boiled with sulphuric acid, the volume of oxygen evolved is not equal to twice the available oxygen of the hydrogen peroxide. The available oxygen in the peroxide solution was estimated by iodometry, the object being to find the available oxygen in 0·56 c.c. of the sample of the peroxide, as this figure represents the volume of 0·0008 gram of oxygen. It is essential that the solution of the peroxide should be dilute, and the sulphuric acid solution should not be stronger than 1 in 5. When stronger solutions of sulphuric acid are added to a solution of potassium iodide, a considerable quantity of iodine is set free before the peroxide solution is added.

The proximate cause of the ready production of iodine when stronger solutions of sulphuric acid are added to a solution of pure potassium iodide is believed to be dissolved oxygen. If, in such a solution containing some starch paste, the blue colour is destroyed by a drop or two of a centinormal sodium thiosulphate solution, the coloration reappears after a definite number of minutes. This regeneration of the blue colour, after its destruction by the thiosulphate solution, will go on for weeks, perhaps for months or even years, until either the potassium iodide or the sulphuric acid has been used up. With hydrochloric acid, the blue colour is reproduced in about one-seventh of the

time required for its reappearance when the equivalent amount of sulphuric acid is employed, and hydriodic acid is almost as active. Tartaric acid is about as active as sulphuric acid, phosphoric acid not not quite so active, oxalic acid still less so, whilst with boric acid the time required for the development of the blue colour is about four days.

The estimation of the available oxygen in a solution of peroxide of hydrogen by an acidified solution of potassium permanganate has been found to be utterly untrustworthy.

Estimations have been made of the available oxygen of manganese dioxide (1) in its original state, (2) after being boiled with a solution of hydrogen peroxide, (3) after being boiled with a solution of hydrogen peroxide and sulphuric acid, the process employed being the oxalic acid method, in which a known weight of manganese dioxide, mixed with a known volume of a normal solution of oxalic acid, and excess of sulphuric acid (1 in 3) is heated until the whole of the dioxide is decomposed, and the excess of oxalic acid then estimated by a standard solution of potassium permanganate. The hydrogen peroxide solution should be added only after the manganese dioxide and sulphuric acid are thoroughly mixed.

The results indicate that (1) the manganese dioxide is not decomposed by the hydrogen peroxide in accordance with the equation $MnO_2 + H_2O_2 = MnO + H_2O + O_2$, as in reality only a portion of the oxygen is evolved, (2) the presence of sulphuric acid is absolutely essential, for without it the foregoing reaction does not occur.

Discussion.

Dr. Divers said that his own experience, as well as that of others, was that a mixture of *pure* potassium iodide and *pure* sulphuric acid if sufficiently dilute would remain colourless in the dark for hours in the presence of starch, even when exposed in an open vessel. In contact with the air, such a likely impurity as a very minute quantity of nitrous acid, although too small to cause an immediate effect, acted slowly as a carrier of oxygen and produced an intense coloration.

Dr. McLachlan, in reply, said that every effort was made to secure pure potassium iodide. Moreover, the action of traces of iodate or nitrous acid would not be an adequate explanation of the phenomena, unless such substances were normal constituents of the atmosphere as distinct from the air of a chemical laboratory.

*133. "The constitution of certain silicates." By C. Simmonds.

Silicates of lead, copper, iron, cobalt, and nickel are reduced when heated to redness in hydrogen, and as a rule a silicate containing x atoms of lead or copper yields x atoms of oxygen. A few naturally occurring ferruginous silicates behave exceptionally under these conditions, some giving up only a portion of the corresponding oxygen, whilst others yield none. The reduced silicates are black powders which, except in the case of lead orthosilicate, do not appear to contain any notable amount of the reduced element in the metallic state.

The formulæ usually adopted do not furnish a simple interpretation of the results obtained on reduction. In lead metasilicate, $O{:}Si\langle{}^{O}_{O}\rangle Pb$, for example, the two oxygen atoms connected with the metal are represented as occupying precisely similar positions in the molecule, and there is no apparent reason why only one should be removed by hydrogen.

The formula of such a silicate ought, however, to indicate that at least one atom of oxygen (the displaceable one) is attached to each atom of lead, and also that this labile oxygen is linked to the metal in a manner differing from the mode of attachment of any other oxygen atom.

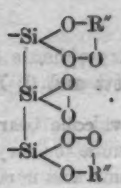
The configuration which satisfies the prescribed conditions most completely is that having the grouping $>Si\langle{}^{O\cdot Pb}_{O\cdot O}$.

The following conclusions have been deduced:

(*a*) The silicon atoms are in direct combination with one another, and not joined by means of oxygen. (*b*) To the chain of silicon atoms thus formed the oxygen corresponding with $(SiO_2)_n$ is attached, giving rise to a mode of grouping denoted by the formula

$$\left(\begin{array}{l} |\\ Si\langle{}^{O-}_{O-}\\ |\\ Si\langle{}^{O-}_{O-}\\ | \end{array}\right)_{\frac{n}{2}}.$$

(*c*) The oxygen valencies still unappropriated are those by which the basic oxides (PbO, CuO, &c.) become attached to the silica complex. (*d*) The conception of silicate structure to which these deductions lead is that of a chain, either closed or open, of the following type:



The two free silicon valencies would presumably unite, the silicate thus acquiring a closed chain or ring structure. Or they may possibly be connected by another molecular group—Al_2O_3, for instance—also giving rise to a ring. They might also conceivably be attached to any univalent atoms or groups, thus forming an open chain.

Whether the above type of structure is the rule or the exception is at present uncertain, but that some diversity exists is shown by the behaviour of those ferruginous silicates (for example, staurolite, augite, and epidote) which are not reduced by hydrogen at a red heat. Possibly, although not necessarily, these differences may be due to the occurrence of an entirely different kind of structure.

The natural silicates which have, so far, been found to undergo practically complete reduction (in the sense already explained) are dioptase, chrysocolla, garnierite, connarite, chloropal, glauconite, cronstedtite, and thuringite. Ilvaite and stilpnomelane show considerable, but not complete, reduction, this action being much less marked in the case of hypersthene.

Discussion.

Mr. C. E. Groves asked the author whether he had treated the *reduced* lead silicate with pure mercury and some acid, such as acetic acid, which did not act either on lead or mercury in order to ascertain whether the lead present in this reduced residue was in the metallic state. If it were not, and the author's formula for lead metasilicate, for instance, $\left(\mathrm{Si}\begin{smallmatrix}\diagup\mathrm{O{\cdot}Pb}\\ \diagdown\mathrm{O{\cdot}O}\end{smallmatrix}\right)_n$, be accepted, the reduced product must be a remarkable lead-silicon compound having the formula $\left(\mathrm{Si}\begin{smallmatrix}\diagup\mathrm{O}\\ \diagdown\mathrm{O}\end{smallmatrix}\!>\mathrm{Pb}\right)_n$.

Mr. Simmonds, in reply, said that he had experimented with mercury, but not with acetic acid, when testing the reduced silicate residues for metallic lead, and he hoped to deal with the matter more fully at some future date. The composition of these residues, however, was a question quite distinct from the one discussed in the paper.

***134. "The constitution of chrysophanic acid and of emodin." By H. A. D. Jowett and C. E. Potter.**

The authors discussed the evidence bearing on the positions of the substituting groups in the formulæ for chrysophanic acid and emodin. They concluded that chrysophanic acid must be represented as 5 : 8-dihydroxy-1-methylanthraquinone, as previously suggested by Hesse, and emodin as 2 : 5 : 8- or 3 : 5 : 8-trihydroxy-1-methylanthraquinone.

Emodin, on fusion with caustic alkali or on oxidation with permanganate, yielded no definite product.

By the action of sodium and methyl iodide on emodin, only the *monomethyl ether*, $C_{16}H_{12}O_4$ (m. p. 200°), was formed; its *diacetyl* compound melts at 157°. This emodin methyl ether appeared to differ from the naturally occurring product obtained by Perkin (*Trans.*, 1894, 65, 932). Attempts to synthesise the foregoing di- and tri-hydroxymethylanthraquinones by the condensation of hydroxysalicylic acid with substituted *o*- and *m*-toluic acids, and also of 1-methylphthalic anhydride with quinol, were unsuccessful.

By the condensation of two molecules of hydroxy-*p*-toluic acid ($CH_3 : OH = 1 : 2$), three isomeric dihydroxydimethylanthraquinones were produced.

3 : 5-*Dihydroxy*-2 : 6-*dimethylanthraquinone*, $C_{16}H_{12}O_4$, which formed yellow leaflets not melting below 300°, yielded a *diacetyl* compound (m. p. 215°) and a *monomethyl ether* (m. p. 214—215°); the latter formed a *monoacetyl* compound (m. p. 195—196°).

1 : 5-*Dihydroxy*-2 : 6-*dimethylanthraquinone* formed red needles (m. p. 224—225°), did not yield a methyl ether, and was insoluble in dilute ammonia.

3 : 7-*Dihydroxy*-2 : 6-*dimethylanthraquinone* formed orange-yellow needles (m. p. 232°) and readily dissolved in dilute ammonia to a red solution.

135. "Conductivity of substances dissolved in certain liquefied gases. Preliminary notice." By B. D. Steele and D. McIntosh.

The authors have studied the behaviour of salt solutions in hydrogen chloride, bromide, iodide, sulphide, and phosphide.

In view of the known dissociation of salts when dissolved in hydrogen fluoride, water, or liquefied ammonia gas, it was anticipated that the foregoing solvents would all behave as ionising media. This anticipation has, however, been only partially realised.

In hydrogen chloride solution, sodium chloride, potassium iodide, ferric chloride, and water do not conduct at all; potassium per-

manganate, sodium acetate, ammonium oxalate, and ammonium chloride diminish the resistance only very slightly, whilst potassium cyanide and several haloid salts of the amines yield highly conducting solutions.

Trichloroacetic acid, sodium chloride, and water do not conduct in hydrogen bromide solution; potassium iodide and potassium bromide conduct very slightly, whereas ammonium acetate, potassium cyanide, diethylammonium chloride, and tetramethylammonium chloride conduct well.

Potassium cyanide, potassium iodide, phosphonium iodide, and water do not diminish the resistance of hydrogen iodide solution, whilst the haloid salts of the amines reduce it considerably.

In hydrogen sulphide solution, hydrochloric acid, sulphuric acid, sodium chloride, and sodium sulphide do not conduct, ammonium chloride conducts only slightly, but ammonium sulphide and the salts of the amines greatly diminish the resistance of the solvent.

Phosphonium iodide, potassium iodide, sodium acetate, ammonium acetate, potassium cyanide, and the salts of the amines do not appreciably reduce the resistance of hydrogen phosphide.

The salts of some of the ammonium bases greatly reduce the resistance of the first four solvents but do not diminish that of liquefied phosphine, and no salt has yet been found which will reduce to any appreciable extent the resistance of this solvent.

It is at present impossible to state whether the cases of non-conduction are due to the insolubility of the salts or to solution unaccompanied by ionisation, but systematic quantitative experiments are being made on the foregoing solvents.

136. "The behaviour of metallic oxides towards fused boric anhydride." By C. H. Burgess and A. Holt, jun.

The authors have investigated the action of fused boric anhydride on many metallic oxides, and find that only a limited number dissolve. Lithium, sodium, potassium, cæsium, and rubidium, as carbonates, readily dissolve in boric anhydride in all proportions up to saturation, giving clear glasses, and thallium behaves in the same way. With a very large amount of alkali, however, the glass becomes opaque.

Calcium, strontium, barium, zinc, cadmium, magnesium, manganese, lead, and bismuth oxides are insoluble in small quantities, but, on gradually increasing the amount, dissolve to clear glasses; with a further addition of oxide, the mass again becomes opaque except in the cases of lead and bismuth, which yield pale yellow, very fusible glasses.

The oxide of mercury appears to be soluble, and those of antimony and arsenic slightly so. The oxides of aluminium, beryllium, zirconium, tin, cerium, thorium, niobium, and silicon are all quite insoluble. The oxides which colour the borax bead, namely, those of chromium, copper, molybdenum, uranium, iron, nickel, and cobalt, are all insoluble in the fused anhydride, the manganese oxides in this respect behaving exceptionally.

The last series of oxides can, however, be dissolved in boric anhydride containing lithium, potassium, cæsium, rubidium, and thallium, and the clear glasses obtained with large amounts of the coloured oxides were similar to the borax beads although the colours were sometimes modified.

137. "Note on some reactions of vanadium tetrachloride." By B. D. Steele.

In a series of experiments undertaken with the object of ascertaining whether vanadium tetrachloride might not find useful application as a chlorinating and condensing agent, it was found that on adding this reagent to benzene, a small quantity of a dark mauve solid was precipitated, the yield of this substance was much increased by boiling the mixture, and 13 grams of dried solid were obtained from 25 grams of benzene and 15 grams of vanadium tetrachloride. Analyses showed that the atomic ratio of chlorine to vanadium varied from 3·08 to 2·73, whilst that between carbon and hydrogen was found to be one. The substance rapidly decreased in weight at the ordinary temperature, and a freshly prepared sample, when heated at 100°, evolved benzene and diminished by 50 per cent., the calculated percentage loss in weight for the compound $VCl_3(C_6H_6)_2$ being 49·7. In the above reaction, the vanadium tetrachloride was reduced to trichloride, and the liberated chlorine atom attacked the benzene molecule, evolving hydrogen chloride and giving rise to chlorobenzene or some other more highly chlorinated substitution products of benzene.

Vanadium tetrachloride failed entirely to bring about chlorination in the case of nitrobenzene, but was used successfully in chlorinating benzene.

When a rapid current of chlorine was passed into a mixture of 4·5 grams of the chloride and 100 grams of benzene, hydrochloric acid was copiously evolved, and sufficient heat was developed to raise the temperature of the solution nearly to its boiling point. On fractionating the product after removal of the vanadium compounds, a considerable quantity of substance boiling between 128° and 132° was obtained, which was identified as chlorobenzene. Crystals of hexa-

chlorobenzene melting at 155° were isolated from the small residue left in the distilling flask.

Vanadium tetrachloride has no value as a condensing agent for use in the laboratory. Acetyl chloride and benzene, when condensed in its presence, gave only a very small yield of acetophenone, and other experiments in this direction led to equally unfavourable results.

It was found that when the mauve compound, $VCl_3(C_6H_5)_2$, reacted with ether, heat was developed and a blue solution was produced which, on evaporation over sulphuric acid in a desiccator, yielded fine, blue, tabular crystals; these could only be kept in the presence of an excess of ether and in a dry atmosphere. Satisfactory analyses of this compound could not be made on account of its instability.

138. "Studies on comparative cryoscopy. Part I. The fatty acids and their derivatives in phenol solution." By P. W. Robertson.

The rate of association of a given compound in any solvent is termed the "assoce," and the constant has been determined for the fatty acids and their derivatives in phenol solution.

The assoce of the normal fatty acids alternately rises and falls as the series is ascended. If the even members are considered, this coefficient reaches a minimum at hexoic acid and then rises rapidly. It is shown that the subsequent rise is probably due to a different kind of association, inasmuch as it is caused by the hydrocarbon portion of the molecule.

The assoce is influenced both by the nature and by the position of a substituting group, and, generally, halogens, alkyl radicles of low molecular weight, and phenyl and benzyl groups have the same influence. In all cases, when these radicles are introduced into the α-position with respect to the carboxyl group the assoce is reduced, but in the other non-contiguous positions they have little or no effect.

Dicarboxylic acids associate more rapidly than the acids from which they are derived, but here again replacement of the α-hydrogen atoms causes a reduction in the rate of association. α-Hydroxyl radicles increase the assoce, but substituted amino-groups tend to change its sign. It is noteworthy that the di- and tri-carboxylic acids and the α-amino-acids are exceedingly insoluble in phenol.

The rates of association of the substituted acetic acids are intimately connected with their velocities of etherification.

139. "Vapour pressures of sulphuric acid solutions. Preliminary note." By B. C. Burt.

Regnault's determinations of the vapour pressure of sulphuric acid solutions were carried out for concentrations varying from 24 to 84 per cent. at temperatures ranging from 5° to 30°. The vapour pressures are now being determined through wider limits of temperature and concentration by means of a modified form of the apparatus described by Innes (*Trans.*, 1902, 81, 683).

The sulphuric acid solutions are heated in a large Jena glass Beckmann tube, having a stout platinum wire sealed through the bottom. Regular ebullition is ensured by the use of small glass beads, and the tube is kept at a constant temperature by a copper jacket containing a suitable liquid boiling under a known pressure.

The experimental tube is connected to a large reservoir, the pressure of which is kept constant by means of the regulator described by Innes. By suitably adjusting the pressure, which is observed to 0·1 mm. by a mercury manometer, the sulphuric acid can be boiled at any required temperature, this being read off by special normal Jena glass mercury thermometers (Goetze).

The appended results indicate the accuracy of the method:

Series A.

Concentration of acid in percentages.	Temperature.	Vapour pressure in mm.
54·70	131°	637·1
54·70	131	637·2
62·07	131	497·9
62·07	131	497·7
62·07	131	497·7
72·88	132	200·2
72·88	132	200·3
79·57	132·5	70·2
79·57	132·5	70·2

Series B.

Concentration of acid in percentages.	Temperature.	Vapour pressure in mm.
72·88	157°	421·6
72·88	157	421·5
79·57	157	182·4
79·57	157	182·2

Chlorobenzene was used as the boiling liquid in series *A*, and bromobenzene in series *B*.

140. "Additive compounds of *s*-trinitrobenzene and alkylated arylamines." By H. Hibbert and J. J. Sudborough.

Mono- and di-alkylated naphthylamines form definite additive compounds with *s*-trinitrobenzene which closely resemble the similar products obtained from α- and β-naphthylamines and the same trinitro-compound. They are stable, red or purplish-black, crystalline substances, and may be crystallised from all the ordinary solvents, including glacial acetic acid, without being resolved into their components, but are readily decomposed by hot dilute mineral acids.

Molecular weight determinations in dilute benzene solution indicate that the dissolved compounds are almost completely resolved into their components.

Most of the monoalkylated derivatives, like the compounds from α- and β-naphthylamines, may be acetylated, whereas the additive compounds from the tertiary bases may be boiled with acetic anhydride for hours without undergoing change.

A *benzoyl* derivative has been obtained by the action of benzoyl chloride and alkali hydroxides on α-naphthylamine trinitrobenzene; it melts at 131—132° and is identical with the compound formed by the union of benzo-α-naphthalide and *s*-trinitrobenzene. *Ethyl-α-naphthylamine s-trinitrobenzene* melts at 153·5—154°, and the corresponding *diethyl* compound at 95—95·5°. *Dimethyl-α-naphthylamine s-trinitrobenzene* melts at 105—106°, and *ethyl-β-naphthylamine s-trinitrobenzene* at 106°, *ethylaceto-β-naphthalide s-trinitrobenzene* and *diethyl-β-naphthylamine s-trinitrobenzene* melt at 77—78° and 116° respectively.

Mono- and di-alkylated anilines also combine with *s*-trinitrobenzene, but the products are extremely unstable, and when crystallised from any of the ordinary solvents, or when exposed to the air at the ordinary temperature, are readily decomposed into their components.

141. "Interaction between chloric and hydriodic acids." By J. McCrae.

The action of chloric acid on hydriodic acid is known to take place according to the equation $6H^{\cdot} + ClO_3' + 6I' = 3I_2 + Cl' + 3H_2O$, and its velocity has been studied by the compensation method by Bray (*J. Physical Chem.*, 1903, **7**, 92). Some experiments on this subject had been carried out prior to the publication of Bray's work, but as they only confirmed these results, the work has been discontinued.

The method at first adopted was to mix definite volumes of standard solutions of potassium chlorate and potassium iodide and add a known

volume of *N* sulphuric acid, so that the concentrations were accurately known. When no acid is added, iodine is not separated, even after 12 months, when the solution is allowed to remain at the ordinary temperature and exposed to daylight. The velocity of the reaction is dependent on the concentration of hydrogen ions, and the reaction is an extremely suitable one for demonstrating the velocity of reaction. If 10 c.c. of 0·2 *N* potassium chlorate solution, 60 c.c. of 0·2 *N* potassium iodide solution, and 15 c.c. of *N* sulphuric acid are mixed, the solution remains almost colourless for a few minutes; a little of the mixture may then be warmed to show that the velocity is accelerated by rise of temperature. In the course of some hours, the intensity of the coloration increases perceptibly, but it is only after six or seven weeks that the maximum reaction has taken place at the ordinary temperature. After definite intervals of time, portions of the solution were titrated with *N*/100 sodium thiosulphate solution, and the velocity of reaction calculated in the ordinary way.

During the course of some experiments with excess of potassium chlorate, it was observed that the concentration of the iodine in solution rose to a maximum and then diminished; at the same time, much iodine had volatilised on to the cork of the flask containing the solution. The same experiment was then made in a glass-stoppered bottle. The maximum intensity of coloration in this case was apparently reached in about six weeks, and soon after iodine began to crystallise out. After about 11 or 12 weeks, the solution was quite colourless, and some very well-developed crystals of iodine were found in the bottle. About two months after the solution had become colourless, the iodine crystals had completely disappeared As there was still the chance of leakage, the same experiment was carried out in a sealed tube. Five c.c. of *N*/5 potassium iodine solution, 45 c.c. of *N*/5 potassium chlorate solution, and 15 c.c. of *N* sulphuric acid were sealed in a wide glass tube, which was then freely exposed to the light. So far as could be judged by the eye, the maximum intensity of coloration was reached in about 24 days, and on the 27th day, crystals of iodine began to separate. The colour of the solution than began to diminish in intensity, and after about 50 days the colour disappeared completely and the quantity of iodine separated was considerable. The iodine then began to dissolve slowly, and after about five months (from the beginning of the experiment) the whole of the iodine passed completely into solution without imparting any colour to the solution; during the period in which this dissolution was taking place, it was frequently noticed that in proximity with each iodine crystal, a yellow solution was formed, as if the iodine were being dissolved *per se*.

These results suggest that the reaction proceeds further than is

denoted by the above equation, and they do not suggest in any way that a definite equilibrium is established.

Saturated solutions of potassium chlorate were sealed in tubes (1) with a small amount of iodine, and (2) with a large excess of iodine. In both cases, the iodine dissolved and the solution became yellow; the intensity of coloration appeared to increase progressively to a maximum after several days, and after four months there is no perceptible evidence of any diminution of the coloration. The fact that the colour only slowly developed shows that it is not due simply to physical dissolution of the iodine in the potassium chlorate solution, but suggests that a chemical reaction has taken place whereby potassium iodide or iodine ions have been formed, which then cause the iodine to pass into solution. As no acid was used in these cases, it is at present not possible to see what bearing the results have on the previous case, where the reaction takes place in presence of acid.

142. "3 : 5-Dichloro-1 : 1 : 2-trimethyl-$\Delta^{2:4}$-dihydrobenzene. A correction." By A. W. Crossley.

Some time ago (*Trans.*, 1901, 79, 144), the author described a substance obtained by the action of phosphorus pentachloride on trimethyldihydroresorcin as 3 : 5-dichloro-1 : 1 : 2-trimethyl-$\Delta^{2:4}$-dihydrobenzene ($\Delta^{2:6}$-dichloro-3 : 4 : 4-trimethyldihydrobenzene),

$$CMe_2\begin{cases}CMe{:}CCl\\CH_2\text{–}CCl\end{cases}CH.$$

On further examination, this compound has been shown to be an aromatic substance and is in reality a *dichlorotrimethylbenzene*. At the time the work was done, it was not known that phosphorus haloids acted on dihydroresorcins to give aromatic derivatives; the fact has only since been established (*Trans.*, 1902, 81, 1536; 1903, 83, 116, 502), moreover as the formulæ of these two substances differ only by two hydrogen atoms, analysis is not of much help in deciding between them.

Dichlorotrimethyldihydrobenzene is produced during the action of phosphorus pentachloride on trimethyldihydroresorcin (*loc. cit.*), and is contained in the liquid boiling at 120—125° under 31 mm. pressure.

The chemical properties of both these substances will be described in detail on a future occasion.

143. "The estimation of hydroxylamine." By H. O. Jones and F. W. Carpenter.

The methods hitherto described for the estimation of hydroxylamine were found to be very untrustworthy in the presence of substances such as neutral metallic salts, although these compounds would not be expected to affect the reactions involved. The following process has been devised, which is free from these objections and is simple and accurate.

Ten to 20 c.c. of the hydroxylamine solution (which should not contain more than 0·5 per cent. of the base) are added to a hot solution of copper potassium carbonate or copper potassium tartrate, which is well stirred during the addition. The mixture is raised to the boiling point, the cuprous oxide at once collected in a Gooch crucible, washed with hot water, and dissolved in ferric sulphate solution in an atmosphere of carbon dioxide, the ferrous salt produced being titrated with potassium permanganate solution as recommended by Wood and Berry (*Proc. Camb. Phil. Soc.*, 1903, 12, ii, 97). Four mols. of the permanganate correspond with 10 mols. of hydroxylamine.

The foregoing reactions are not affected by the presence of foreign substances provided that these do not reduce the copper solutions, and the method may be applied to mixtures containing sodium, potassium, ammonia, cobalt, nickel, and zinc salts, carbon dioxide, alcohol, acetic acid, and ketoximes.

144. "A study of the isomerism and optical activity of quinquevalent nitrogen compounds." By H. O. Jones.

An attempt has been made to prepare isomerides of quaternary ammonium compounds of the type $N{\cdot}R'R''R_2'''X$. The existence of these isomerides is theoretically possible on any configuration of the nitrogen atom, since it has been proved conclusively by the work of Pope and his colleagues that the configuration of radicles about a quinquevalent nitrogen atom is a stable one giving rise to optical activity. Taking Bischoff's "pyramidal" configuration, which affords the best explanation of the facts at present known, two isomerides are to be expected, one of which should be capable of existing in optically active forms.

Seven compounds of the desired type have been produced (with one exception in two different ways) and their properties studied, but no evidence of isomerism was obtained. The compounds have been examined for optical activity by the fractional crystallisation of the *d*-cam-

phorsulphonate and the *d*-bromocamphorsulphonate from non-hydroxylic solvents; in no case was any resolution effected, so that the compound produced in all cases has a planisymmetric configuration. The absence of isomerism is discussed in the light of Kipping's results on the isomerism of compounds of the type NRH_3X, in which R and X both contain an asymmetric carbon atom.

Optical activity due to an asymmetric nitrogen atom is to be expected in α- and β-substituted pyridinium compounds and in certain tetrahydroquinolinium derivatives. Several of these compounds have been examined by the method already mentioned, but for some unknown reason no resolution could be effected.

d-*Phenylbenzylmethylethylammonium* d-*camphorsulphonate* melts at 181° and the corresponding d-*iodide* at 146—147°; the *platinichloride* of *d*-phenylmethylethylallylammonium *d*-bromocamphorsulphonate melts at 159—160°.

145. "The influence of various substituents on the optical activity of tartramide." By P. F. Frankland and A. Slator.

This paper forms a part of the systematic investigation being made by one of the authors on the connection between the rotation and chemical constitution of optically active molecules. The preparation and properties of seventeen derivatives of tartramide are described, the series including the methyl, ethyl, and benzyl amides, the anilide toluidides (*o*-, *m*-, and *p*-), and α- and β-naphthylamides; the anil and *p*-toluil; the hydrazide and phenylhydrazide; the hydrazones of benzaldehyde, furfuraldehyde, and acetophenone; as well as the *o*-toluidide of diacetyltartaric acid.

In order to avoid errors arising from the possible racemisation of the tartaric acid, the compounds have, in nearly all cases, been prepared by the direct interaction of acid and base, as well as by acting with the base on an ethereal salt of the acid; but, although the latter reaction could generally be made to take place at a lower temperature than the former, no substantial difference in the optical activity of the products was discoverable.

All the compounds were, like tartramide itself, dextrorotatory. The molecular rotation is considerably increased by the introduction of the methyl, ethyl, and benzyl groups, whilst a much greater augmentation is effected by the introduction of the aromatic radicles, the highest rotation being obtained in the case of the β-naphthylamide.

The two imides—tartranil and tartaric *p*-toluil—have much lower rotations than the corresponding diamides—tartranilide and tartaric *p*-toluidide—notwithstanding the cyclic groupings present in the former

compounds. Similarly, low rotations have, however, also been found by Walden for malanil and malic β-naphthimide.

The molecular rotation of tartaric hydrazide is very slightly greater than that of tartramide, whilst that of the phenylhydrazide is much less than that of either; but, on the other hand, the hydrazones have very high rotations, a circumstance which is very probably due to the double linking which they contain, this grouping, whether between two atoms of carbon or between carbon and nitrogen, being known to exert a powerful influence on the rotation.

146. "The influence of cyclic radicles on optical activity: tartaric *ar*- and *ac*-tetrahydro-β-naphthylamides, furfurylamide, and piperidide." By P. F. Frankland and E. Ormerod.

The authors describe the preparation and properties of the above compounds. As anticipated, the *ar*-tetrahydro-β-naphthylamide has a molecular rotation, $[M]_D^{20°}$ +840°, of the same order as those of the ordinary aromatic amides of tartaric acid, whilst the rotation of the *ac*-tetrahydro-β-naphthylamide, $[M]_D^{20°}$ +240°, is very much lower, being of the same order as those of the fatty amides: methylamide, $[M]_D^{20°}$ +278°, and ethylamide, +279°.

It has been shown by P. Frankland and F. W. Aston (*Trans.*, 1901, 79, 514) that the rotatory influence of the pyromucyl radicle is very similar to that of the benzoyl and toluyl groups, from which is to be inferred that the furfuran and benzene rings resemble each other in rotatory effect. It would be expected, therefore, that the furfurylamide should have a molecular rotation of the same order as that of the benzylamide; as a matter of fact, they were found to be practically identical, thus:

	$[M]_D^{20°}$.
Tartaric dibenzylamide	+300°
„ difurfurylamide	+300—307°

Tartaric dipiperidide was found to be practically inactive.

147. "The rotatory power of maldiamide, maldi-n-propylamide, and maldibenzylamide." By J. McCrae.

Maldi-n-propylamide and *maldibenzylamide* were prepared by heating diethyl *l*-malate with *n*-propylamine and benzylamine respectively. The propylamide melts at 125·5° and the benzylamide at 155·5°.

The specific rotations are: in acetic acid ($c = 4·7$ to 5), maldiamide, −45·2°; maldi-*n*-propylamide, −47°; maldibenzylamide, −20·2°; in

pyridine, maldiamide ($c = 2$), $-57{\cdot}7°$; maldi-*n*-propylamide, $-41{\cdot}9°$; maldibenzylamide, $-32{\cdot}4°$.

By comparing these results with those obtained by Guye and Babel and by Walden for the corresponding anilide and toluidides, it is seen that the effect produced on the rotatory power by the introduction of benzyl groups into maldiamide is similar to that caused by introducing fatty alkyl groups, but is different from that brought about by replacing hydrogen of the amino-groups by aryl radicles.

148. "Further experiments with phosphorus sesquisulphide." By E. G. Clayton.

In a previous communication (*Proc.*, 1902, 129), it was shown that commercial phosphorus sesquisulphide of good quality had been found to give no reaction with Mitscherlich's test. With the object of studying under what conditions, oxidation, or a similar change, is promoted, and whether, by keeping, this compound acquires the property of yielding a luminous vapour when distilled with dilute sulphuric acid, the author has exposed specimens, which had previously given negative results, for various periods under different conditions, the products being then subjected to Mitscherlich's test.

Experiment.	Atmosphere in which the phosphorus sesquisulphide was exposed.	Capacity and nature of vessel.	Time of exposure in months.	Quantities taken of phosphorus sesquisulphide and 10 per cent. acid.	Observation.
				grms. c.c.	
1	Dry air.	Tightly corked, wide-mouthed bottle, about 90 c.c. capacity.	6	10 50	Negative result. No phosphorescence at any stage of the experiment, or in any portion of the apparatus.
2	Air mixed with acetic acid and water-vapour.	Bell-jar, 4 litres' capacity.	6	20 100	Result as above.
3	Somewhat damp air.	Loosely stoppered, wide-mouthed bottle, 300 c.c. capacity.	6	20 100	When 35 c.c. had distilled, a faint luminosity appeared on cooling in the upper coils of the spiral condenser and in the flask.

Experiment.	Atmosphere in which the phosphorus sesquisulphide was exposed.	Capacity and nature of vessel.	Time of exposure in months.	Quantities taken of phosphorus sesquisulphide and 10 per cent. acid.	Observation.
				grms. c.c.	
4	Air saturated with moisture.*	Glass shade, 21 litres' capacity.	6	5 32	Strong phosphorescence in flask, connecting tube, and coils of condenser. On cooling, a vertical stream of luminous vapour descended into the flask.
5	Air saturated with water-vapour.*	Bell-jar, 4 litres' capacity.	1	10 50	Similar reaction, but less marked.
6	Atmosphere mingled with ammonia, carbon dioxide, and water-vapour.	Bell-jar, 4 litres' capacity.	6	20 100	Excessively faint phosphorescence in upper coils, none in flask.
7	Air impregnated with hydrochloric acid.	Glass shade, 21 litres' capacity.	6	20 100	After 30 c.c. had distilled, phosphorescence appeared in upper coils and connecting tube, none in flask.
8	Air over sulphuric acid. [The acid became brown and diluted in the course of the experiment, the air being evidently moist.]	Glass shade, 3·75 litres' capacity.	6	20 100	Towards the end of the experiment, a feeble glow appeared, visible in the upper coils of the condenser only.
9	Atmosphere impregnated with nitrogen oxides.	Glass shade, 21 litres' capacity.	2	10 50	Before 5 c.c. had distilled over, a very strong phosphorescence appeared on cooling, and a vertical stream of light descended into the flask, the interior of which became luminous for several minutes.

* In these cases, a garlic odour was perceptible when the glass vessels were removed.

Experiment.	Atmosphere in which the phosphorus sesquisulphide was exposed.	Capacity and nature of vessel.	Time of exposure in months.	Quantities taken of phosphorus sesquisulphide and 10 per cent. acid.	Observation.
				grams c.c.	
10	Air of average humidity.	Beaker, 300 c.c. capacity.	2¾	20 100	When 30 c.c. had distilled, a distinct but slight luminosity was visible in the upper coils and connecting tube, although not in the flask.
11	Air of average humidity.	Glass shade, 21 litres' capacity.	2¾	20 100	After 40 c.c. had passed over, traces of phosphorescence were noticed in tube and coils, but none in flask.

Experiments 9, 10, and 11 were made at a later date than the rest, consequently with a sample of sesquisulphide which had already been kept in the laboratory for a longer period. The last two experiments were made with the view of investigating the influence, if any, of the size of the vessel, but the results were not markedly different.

The temperature of the laboratory, of course, fluctuated considerably, but similar variations were experienced by samples exposed for the same periods.

From the results of these experiments, in which the author was assisted by Mr. G. N. Bacon, it is evident that good commercial phosphorus sesquisulphide undergoes little change if preserved in air of average dryness in nearly filled, well-closed vessels, but that the progress of the oxidation is appreciable in a damp atmosphere or in imperfectly closed vessels; this action takes place particularly rapidly in air saturated with moisture, and perhaps to the greatest extent in the presence of acid vapours, especially such as nitrogen peroxide.

Comparative experiments were made with yellow phosphorus, from which a luminous vapour passed over almost as soon as distillation began. With phosphorus sesquisulphide, on the other hand, the phosphorescence in most cases was seen only after the pressure had been diminished by the removal of the lamp, and after a considerable

proportion of the liquid had distilled over. The author's experiments confirm J. Mai and F. Schaffer's observation (*Ber.*, 1903, **36**, 870; also *J. Soc. Chem. Ind.*, 1903, **22**, 511) that the glow differs from that of yellow phosphorus.

RESEARCH FUND.

A Meeting of the Research Fund Committee will be held in December. Applications for grants, to be made on forms which can be obtained from the Assistant Secretary, must be received on or before December 7th.

At the next ordinary meeting, on **Wednesday**, November 18th, 1903, at 5.30 p.m., the following papers will be communicated:—

"Constitution of ethyl cyanoacetate. Condensation of ethyl cyanoacetate with its enolic form." By P. Remfrey, and J. F. Thorpe.

"The action of water and dilute caustic soda solutions on crystalline and amorphous arsenic." By W. T. Cooke.

"The union of carbon monoxide and oxygen and the drying of gases by cooling." By A. F. Girvan.

"Note on a double chloride of molybdenum and potassium." By G. G. Henderson.

"Simplification of Zeisel's method for the determination of methoxy- and ethoxy-groups." By W. H. Perkin.

"The action of benzamidine on olefine β-diketones." By S. Ruhemann.

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Issued 28/11/03

PROCEEDINGS

OF THE

CHEMICAL SOCIETY.

Vol. 19. No. 271.

Wednesday, November 18th, 1903. Professor W. A. TILDEN, D.Sc., F.R.S., President, in the Chair.

Certificates were read for the first time in favour of Messrs.

Allan Baguley, B.Sc., University College, Bangor.
James Rocheid Forrest, D.P.H., Kirkee, near Poona, India.
Harry James Glover, 33, Albert Road, Stroud Green, N.
John Augustus Goodson, 19, Darnley Road, Hackney, N.E.
Alfred Henry Hoit, 4, Montgomerie Road, Southsea.
Bernard Middleditch, B.A., Woodcroft, Harrow-on-the-Hill.
Bertram Prentice, Ph.D., D.Sc., Royal Technical Institute, Salford.
Frederick Henry Streatfeild, 9, Crescent Road, South Tottenham, N.
William Wood Underhill, 10, Hartham Road, Holloway, N.
Francis Langston Watt, 111, Lauderdale Mansions, Maida Vale, W.

The PRESIDENT announced that the Librarian had reported that the following books were missing from the Library:

Lunge, G. A treatise on the distillation of coal-tar and ammoniacal liquor and the separation from them of valuable products. London 1882.

Ganot, A. Elementary treatise on physics. Trans. by E. Atkinson. 6th edition. London 1873.

Muir, M. M. P. The alchemical essence and the chemical element. An episode in the quest of the unchanging. London 1894.

Pamphlets, Vol. 6.

Centralblatt für Bakteriologie. Bd. 23.

He would be glad if Fellows would do what they could to assist the Librarian in recovering these missing volumes.

Of the following papers, those marked * were read :

***149. "The union of carbon monoxide and oxygen and the drying of gases by cooling." By A. F. Girvan.**

The following experiments were made in order to investigate whether the drying of an explosive mixture of carbon monoxide and oxygen by exposure to low temperatures was sufficient to prevent chemical union taking place when the gas was sparked after it had regained the ordinary temperature.

A small glass gas-holder containing the explosive mixture was sealed to the following apparatus arranged in series: (1) a small bubbler containing water, (2) a stopcock, (3) a vertical glass spiral, (4) a glass tube, one centimetre in diameter, furnished with platinum terminals with a spark gap of about 4 mm., (5) a stopcock, (6) a Töpler pump. Stopcocks were sealed as side-tubes between (2) and (3) and between (5) and (6). The carbon monoxide was prepared by the interaction of "pure" sulphuric and formic acids, the oxygen being obtained by heating potassium permanganate; the gases were collected and stored over water and the proportion was correct to within 1 per cent.

A slow current of air was aspirated through the apparatus by means of the side-taps, while the whole apparatus between them was thoroughly heated. The spiral was then surrounded by a freezing mixture and the tube between it and the pump was heated to the softening point of the glass. After some time, the current of air was stopped and the heating discontinued. The apparatus was then completely exhausted as far as the bubbler by means of the Töpler pump and the explosive mixture slowly admitted at the rate of one bubble per second. When the gas in the apparatus was under atmospheric pressure, the tap of the gas-holder was closed and sparks from an induction coil were passed through the explosion tube in which the gas was now at the temperature of the atmosphere.

In the first experiments, where liquid air was used, care had to be taken that this cooling agent was not too fresh, as it was then sufficiently cold to liquefy the explosive mixture. No explosion took place on passing sparks from an induction coil which, at the same time, was giving 12 mm. sparks in the air, although the sparks in the gaseous mixture were usually surrounded with a little ball of blue flame. When the glass spiral was allowed to regain the ordinary temperature, the moisture which had been condensed in the spiral slowly diffused into the explosion-tube and a single spark exploded the mixture with a sharp report.

On sparking the mixed gases which had been cooled in a mixture of solid carbon dioxide and alcohol (−80°), there was no explosion, and the little ball of flame round the sparks had much the same appearance as when the gases had been dried at −180°, but when the glass spiral had acquired the ordinary temperature, a single spark produced a sharp explosion. When the gaseous mixture had been cooled to −15° and allowed to regain the ordinary temperature, the first spark always caused an explosion, but this did not occur after cooling below −50°. When dried between −50° and −35°, faint sparks did not, as a rule, cause the mixture to explode, although powerful sparks always produced this effect. The freezing mixture employed was either liquid air or solid carbon dioxide in alcohol, and when kept in a vacuum-vessel its temperature rose only about half a degree per minute, even when a current of air was passing through the spiral.

A single powerful spark, when passed through the mixture (after drying between −50° and −35°), frequently produced no effect, whereas an explosion always occurred on passing the second or third spark.

The explosion produced by powerful sparks in the gases dried between −50° and −35° is of a very different character from that obtained with the wet gases; the latter is very quick and violent and gives a metallic click, but the former takes place quietly, and the explosive wave often travels quite slowly along the tube (compare Dixon, *Phil. Trans.*, 1884, 175, II, 630). The wave proceeding from these feeble explosions always stopped directly it reached the cold part of the spiral, and the gas in this part of the apparatus was found to be unaltered, but when the gas was moist and the spiral at the ordinary temperature, the explosion passed to the furthest part of the apparatus.

The platinum terminals were now replaced by (1) a silver wire, (2) a gold wire: each of these was heated to redness and then fused by an electric current, without causing any visible union in the explosive mixture, which had been dried at about −80°. In order to find out whether platinum would act catalytically on the dried or partly dried gases (compare Dixon, *loc. cit.*), a tube, in which the platinum terminals were replaced by a coil of platinum wire, was sealed in place of the sparking-tube and the apparatus dried as before. The explosive mixture was then allowed to enter through the spiral, which was kept at various temperatures.

With a mixture dried at about −35°, the platinum acted catalytically, and in becoming heated to redness brought about a quiet and feeble explosion. When, however, the mixture was dried at temperatures between −80° and −180°, the platinum still acted

catalytically and glowed for several seconds, but there was no other sign of chemical action. After the glowing had ceased, the coil was kept at a white heat for several minutes by means of an electric current, and the gas was then pumped off and collected. About one-eighth of the gaseous mixture was absorbed in caustic potash solution and the residue was still explosive, showing that combination was far from complete.

At Sir William Ramsay's suggestion, the author calculated the amount of moisture present in the mixture after cooling (compare *Trans.*, 1886, 49, 46), the following data being employed:

Temperatures	−61°	−56·5°	−51°	−45°	−36°
Pressures in mm.	0·008	0·01	50·029	0·052	0·160

When the vapour pressure of the water is less than about 0·03 mm., as is the case with the mixture after cooling at −50°, the gases will not explode. When the vapour pressure is less than about 0·16 mm., the explosion is very feeble.

In the first case, the amount of water vapour present is about one part in twenty-four thousand by volume, and in the second, one part in five thousand. At −61°, the amount of water vapour would be about one part in a hundred thousand of gas.

It would appear then that the mixture will not explode when sparked at the ordinary temperature if there is less than one mol. of water vapour to twenty-four thousand mols. of the gas.

These figures must, however, be taken as being only approximate, since below −50° the vapour pressure of ice falls to half its value for a decrease of about 7°, and, moreover, it is not known whether the glass of the apparatus exerts any drying effect on the contained gas.

Discussion.

Sir W. Ramsay pointed out the interest of Mr. Girvan's experiments in connection with surface-layers on glass. The water-vapour in contact with the water-layer on the glass must have a vapour-pressure comparable with, or less than, the vapour-pressure in contact with ice at −185°. This film is removed on heating the glass in a current of dry air, and is not removed when the mixed gases, dried at −60°, are allowed to enter the dried tube. Such questions are of very great interest from the standpoint of molecular physics, and Mr. Girvan, he knew, hoped to attack these and similar problems at an early opportunity.

Dr. Scott suggested that the water which adhered to the glass might be there not as a gaseous layer but either as a hydrated silicate or in combination with alkali.

***150. "Simplification of Zeisel's method of methoxyl and ethoxyl determinations." By W. H. Perkin.**

In this process, a long-necked distilling flask was employed without any other condensing arrangement, the tube for the current of carbon dioxide being passed down the neck to within a short distance of the hydriodic acid. It was eventually found that as long as the temperature of the glycerin bath was so adjusted that actual distillation of the acid into the delivery tube did not take place, no appreciable quantity of hydrogen iodide passed forward into the silver nitrate flasks. The acid used boiled at 126° and had a sp. gr. of 1·68 approximately.

The following arrangement has been found to prevent the silver nitrate solution from being sucked back into the distilling flask after a sudden ebullition of hydriodic acid. Two small flasks are used as usual, but the tube conducting the carbon dioxide and methyl iodide vapour, instead of passing into the silver solution, is kept some distance above its surface. The flasks are then connected with a siphon tube, one arm of which reaches to within a short distance of the solution in the first flask, whilst the other arm dips a little below the surface in the second. By this arrangement, the methyl iodide is chiefly absorbed by the surface of the silver solution, but any escaping is caught as it bubbles through the second quantity, then, if any such drawing back takes place, some of the solution passes into the first flask, and as soon as the pressure increases is forced back again into the second.

This method of determining the methoxyl group gave very good numbers and can be used equally well for determining the ethoxyl group, but in this case the numbers are not usually so accurate, being generally a little less than the calculated quantity.

***151. "The rusting of iron. Part II." By G. T. Moody.**

The author has further investigated the causes of the rusting of iron, more particularly with reference to the influence of soluble substances, and finds that the salts of strong acids, such as sodium chloride and sulphate, potassium sulphate, ammonium sulphate, magnesium chloride and sulphate, calcium chloride and sulphate, and potassium chlorate have no retarding influence on rusting. These salts do not combine with and are not decomposed by carbonic acid. Compounds which inhibit rusting may be divided into two classes. The first contains substances having an alkaline reaction, such as sodium carbonate, hydroxide, phosphate and borate, ammonium carbonate, and

barium and calcium hydroxides, all of which directly absorb and combine with carbonic acid. The second class includes salts of weak acids, such as potassium and sodium nitrites, sodium formate, sodium acetate, potassium ferrocyanide and chromate. These salts are all decomposed by carbonic acid. Sodium nitrite solution, for example, after exposure to air becomes alkaline and contains sodium carbonate. A solution of 10 grams of the nitrite, through which a slow stream of carbon dioxide was passed for 9 days, contained 1·585 grams of sodium carbonate. Similarly, potassium ferrocyanide solution, when exposed to air, slowly evolves hydrogen cyanide and becomes alkaline. This change occurs more rapidly when carbon dioxide is passed through the solution, the escaping gas having the odour of hydrogen cyanide and precipitating silver cyanide from a solution of silver nitrate. Potassium ferricyanide is a salt of a weak acid which exceptionally does not appear to retard rusting. This substance is, however, reduced by iron whether its solution be exposed to air or not, the metal becoming covered in either case with a mass of insoluble, greenish-blue cyanide.

It may therefore be concluded that the influence of any particular compound on the atmospheric rusting of iron depends on its behaviour towards carbonic acid, and that only those substances which combine with or are decomposed by carbonic acid inhibit rusting.

Dunstan has stated (*Proceedings of the Royal Artillery Institution*, 1899, 5, 26, and this vol., p. 150) that the metals which rust in air are oxidised by hydrogen peroxide, whilst those which are not oxidised by this reagent do not rust in air. Iron, zinc, and lead are cited as examples of the first class, and copper, silver, and nickel as types of the second. It is noteworthy that iron and zinc rapidly decompose aqueous carbonic acid, whilst copper, silver, and nickel are indifferent to the acid. Having regard to this, and also to the fact that Giorgis (*Gazzetta*, 1891, 21, 510) has shown that hydrogen peroxide, when carefully freed from carbon dioxide, is practically without action on magnesium, it appeared probable that iron would not be oxidised by pure hydrogen peroxide. The author has investigated this question by leaving a specimen of distilled hydrogen peroxide in contact with iron for fourteen days. No oxidation of the iron was observed, but on adding to a further portion of the pure peroxide containing iron a drop of hydrochloric acid or a solution of carbon dioxide, hydrated ferric oxide was formed.

In the light of the experiments described, the aërial rusting of iron cannot be attributed to hydrogen peroxide, but must be regarded as a change involving the interaction of iron and acid and subsequent formation of rust by the oxidation of ferrous salt.

Discussion.

Dr. Rideal remarked that Müntz had shown (*Compt. rend.*, 1891, 112, 1142) that calcium nitrite in sterilised soil gave off nitrous acid rapidly in presence of carbonic acid, and that he had noticed this reaction in bacterial sewage filters.

Mr. W. A. Davis pointed out that the decomposition brought about in aqueous solutions of sodium nitrite and potassium ferrocyanide, although at first sight surprising, was a necessary consequence of the principle of mass action. As both nitrous and hydrocyanic acids are volatile, the conversion of their salts into carbonates by an excess of carbonic acid should be complete after a sufficient interval of time.

Dr. Moody, in reply, said that the sodium nitrite used, which was a well-crystallised specimen, having a high degree of purity and quite free from carbonate, was so sensitive to carbon dioxide that the gas, after passing through the solution, immediately reacted with potassium iodide and starch solution.

152. "Constitution of ethyl cyanoacetate. Condensation of ethyl cyanoacetate with its sodium derivative." By F. G. P. Remfry and J. F. Thorpe.

When ethyl sodiocyanoacetate is heated in alcoholic solution for 2 hours at 100° with a molecular proportion of ethyl cyanoacetate, a 70 per cent. yield of the *compound*, $CN\cdot CH_2\cdot HC(OEt)\cdot O\cdot CH(CN)\cdot CO_2Et$, is produced, which crystallises from dilute alcohol in long needles, melts at 53°, and distils with partial decomposition at 235° under 20 mm. pressure. On boiling with sodium carbonate solution, this substance dissolves, and, on acidifying the solution, the *acid*, $CN\cdot CH_2\cdot HC(OEt)\cdot O\cdot CH(CN)\cdot CO_2H$, separates; it crystallises from water in large prisms and melts at 142° with evolution of carbon dioxide, being converted into a *substance* having the formula $(C_7H_{10}O_2N_2)_x$, which crystallises from glacial acid in small, yellow needles having no definite melting point; on distillation, it gives rise to the *compound* $CN\cdot CH_2\cdot HC(OEt)\cdot O\cdot CH_2\cdot CN$, separating from absolute alcohol in large prisms melting at 181° and boiling at 208° under 25 mm. pressure. The same substance is produced quantitatively if the ammonium salt of the acid melting at 142° is distilled under diminished pressure.

Concentrated aqueous potash hydrolyses the substances melting at 53° and 142°, forming malonic acid; the compound melting at 181°, when similarly treated, yields malonic and acetic acids.

When the sodium compound of the condensation product is heated directly with methyl iodide, the *methyl* compound,

$$CN\cdot CHMe\cdot HC(OEt)\cdot O\cdot CH(CN)\cdot CO_2Et,$$

is produced; it crystallises from dilute alcohol in small prisms, melts at 63°, and boils without decomposition at 220° under 20 mm. pressure. With sodium carbonate, the *acid*,

$$CN\cdot CHMe\cdot HC(OEt)\cdot O\cdot CH(CN)\cdot CO_2H,$$

is produced; it crystallises from water in glistening plates, melts at 145° with evolution of carbon dioxide, and becomes converted into a compound, $(C_8H_{10}O_2N_2)_x$, having no definite melting point, but which, on distillation, is converted into the *substance*,

$$CN\cdot CHMe\cdot HC(OEt)\cdot O\cdot CH_2\cdot CN,$$

crystallising from absolute alcohol in small prisms and melting at 121°. The same substance is produced when the acid melting at 145° is boiled for some time with sodium carbonate solution, or when its ammonium salt is distilled. The substances melting at 63° and at 145° give, on hydrolysis with aqueous caustic potash, malonic and methylmalonic acids; the compound melting at 121° yields methylmalonic and acetic acids.

When the sodium compound of the condensation product is treated directly with ethyl iodide, it is converted into the *ethyl* compound, $CN\cdot CHEt\cdot HC(OEt)\cdot O\cdot CH(CN)\cdot CO_2Et$, which crystallises from dilute alcohol in prisms, melts at 68°, and boils without decomposition at 215° under 20 mm. pressure. With sodium carbonate, it yields the *acid*, $CN\cdot CHEt\cdot HC(OEt)\cdot O\cdot CH(CN)\cdot CO_2H$, which crystallises from water and melts at 153° with evolution of carbon dioxide and becomes converted into an infusible substance having the formula $(C_9H_{14}O_2N_2)_x$. The latter compound, on distillation, gives rise to the substance $CN\cdot CHEt\cdot HC(OEt)\cdot O\cdot CH_2\cdot CN$, which crystallises from absolute alcohol in small plates melting at 115°.

Complete hydrolysis of the above-mentioned substances melting at 68° and at 153° gives rise to malonic and ethylmalonic acids; the compound melting at 115° yields ethylmalonic and acetic acids.

When the substance melting at 53° is treated with excess of sodium ethoxide and methyl iodide, it is converted into the *trimethyl* compound, $CN\cdot C(Me)_2\cdot HC(OEt)\cdot O\cdot CMe(CN)\cdot CO_2Et$, which crystallises from dilute alcohol in small needles and melts at 120°. Complete hydrolysis of this substance with aqueous potash gives rise to methylmalonic and dimethylmalonic acids.

The action of acidic hydrolytic agents on these substances, and the condition governing the formation of similar condensation products from substituted ethyl cyanoacetates, is under investigation.

153. "The action of water and dilute caustic soda solutions on crystalline and amorphous arsenic." By W. T. Cooke.

Engel (*Compt. rend.*, 1883, 96, 1314) states that amorphous arsenic is unaltered in moist air, whilst the crystalline modification oxidises rapidly. The author's experiments were made with the view of ascertaining: (1) whether water alone had any action on either variety, (2) whether the action, if any, was increased by the presence of caustic soda, (3) and whether, in the presence of air, the crystalline variety dissolved to a greater extent in caustic soda solution than in water.

Amorphous Arsenic.—The operations were carried out entirely in an inert atmosphere, the gas employed being either carbon dioxide or hydrogen, according as water or caustic soda solution was used. The main part of the apparatus consisted of two boiling tubes provided with condensers and also with tubes for the introduction of the gas. Hydrogen arsenide was passed into one carefully dried boiling tube, so that arsenic was deposited on warming. The water or caustic soda solution contained in the other tube was freed from air by boiling and by passing through it a current of hydrogen or carbon dioxide. The pressure of the gas in the apparatus was then used to force over the solution into the tube containing the arsenic, after any remaining hydrogen arsenide had been expelled. The solution could then be boiled in contact with the arsenic for any desired time, and finally drawn off through an asbestos filter. The arsenic in the filtrate was usually estimated by titrating with iodine solution.

The following results were obtained using 125 c.c. of distilled water:

Time of boiling in hours	2·5	1·5	2·5	3	4	6
Weight of dissolved arsenic in grams...	0·0020	0·0009	0·0004	0·0034	0·0013	0·0016

In the absence of air, the action of water on amorphous arsenic is thus seen to be very slight. When air was aspirated through the boiling water for 6½ hours in contact with the amorphous arsenic, only 0·0010 gram of the element was dissolved, hence the presence of air has no effect.

In the absence of air, the effect of dilute caustic soda solutions was slightly greater than that of water, and the action increases with the

concentration of the alkali. Moreover, the action is not influenced by the presence of air.

In the absence of air.			In the presence of air.		
Concentration.	Time of boiling, in hours.	Weight of dissolved arsenic in grams.	Concentration.	Time of boiling, in hours.	Weight of dissolved arsenic in grams.
N/100	1·5	0·0022	*N*/100	2·75	0·0014
	5·3	0·0026		6·0	0·0014
N/50	3·5	0·0021	*N*/50	2·5	0·0038
	6·0	0·0020		6·0	0·0010
N/25	6·0	0·0038	*N*/25	6·0	0·0046
				6·0	0·0014

Crystalline Arsenic.—In this case, the boiling tube was provided with a side tubulure, through which the crystalline arsenic could be introduced. The arsenic was powdered and introduced into the apparatus as quickly as possible on account of the readiness with which the finely divided element undergoes oxidation. The volume of liquid used was 50 c.c. When distilled water was used and air excluded, about 0·0025 gram of arsenic dissolved in 1½ to 1½ hours.

With distilled water in presence of air, about 0·0233 gram of arsenic dissolved in 1½ hours. Hence the presence of air greatly increases the action in the case of the crystalline modification of the element. The following results obtained with caustic soda show that the alkali does not materially increase the action.

In the absence of air.			In the presence of air.		
Concentration.	Time of boiling, in hours.	Weight of dissolved arsenic in grams.	Concentration.	Time of boiling, in hours.	Weight of dissolved arsenic in grams.
N/100	6	0·0025	*N*/100	6	0·0712
N/50	6	0·0016	*N*/50	6	0·0797
N/25	6	0·0030	*N*/25	6	0·0267
	6	0·0017			

By estimating the dissolved arsenic by the iodometric and gravimetric methods, it was found to be entirely in the form of arsenious acid.

The results seem to show that water either alone or in the presence of caustic soda has practically no action on arsenic. In the presence of air, however, direct oxidation takes place. If water is concerned in the oxidation, the formation of hydrogen arsenide might be anticipated: $2As + 3H_2O = As_2O_3 + 6H$, $2As + 6H = 2AsH_3$; but this gas was never found in the foregoing experiments.

Th. Panzer (*Chem. Centr.*, 1903, ii, 821), has also shown that the oxidation of arsenic in moist air is due not to the decomposition of water, but to the intervention of free oxygen.

154. "Note on a double chloride of molybdenum and potassium." By G. G. Henderson.

According to Berzelius (*Poggendorff's Annalen*, 1826, 6, 331, 339; 7, 261), a chloride of molybdenum and potassium is obtained when the black liquid produced by the action of potassium amalgam on a solution of molybdenum pentachloride is evaporated to the crystallising point, and is described as a black, efflorescent salt, which, when redissolved in water, leaves a black powder, probably a basic salt.

A definite *double chloride* of molybdenum and potassium, having the formula $3KCl,MoCl_3,2H_2O$, has been prepared in the following manner: potassium amalgam was added, in small quantities at a time, to a solution of molybdic acid in excess of hydrochloric acid until the liquid had acquired a purple-black colour. The solution was concentrated and saturated with gaseous hydrochloric acid, when successive crops of crystals were obtained; the first was composed of potassium chloride alone, the second of a mixture of potassium chloride with red crystals of the double salt, and the third of the double salt alone. The red crystals were collected, washed with fuming hydrochloric acid, dried by pressure between folds of filter paper, and analysed with the following result:

Found: Mo = 21·39; Cl = 45·46; H_2O = 7·47.

$3KCl,MoCl_3,2H_2O$ requires Mo = 20·92; Cl = 45·80; H_2O = 7·80 per cent.

The new salt, which crystallises in garnet-red prisms, is fairly easily soluble in cold water, without any apparent decomposition, giving a deep red solution. In the dry state, the salt is quite stable, but it decomposes in aqueous solution, slowly in the cold, but quickly on boiling; this decomposition is prevented by the presence of hydrochloric acid. The salt is dissolved, to a small extent, by concentrated hydrochloric acid, which then acquires a deep red colour.

When a solution of molybdic acid in hydrochloric acid was reduced in a similar manner by sodium amalgam, a few red crystals were

obtained, very similar in appearance to those of the potassium salt; they probably consisted of the corresponding double chloride of molybdenum and sodium, but were not analysed on account of the difficulty of freeing them from admixed sodium chloride.

An attempt was made to prepare the potassium salt by adding potassium chloride to a concentrated solution of molybdic hydroxide, $Mo(OH)_3$, in hydrochloric acid, and subsequent saturation of the liquid with gaseous hydrochloric acid, but in this case the brilliant, green crystals of the compound $2KCl,MoOCl_3,2H_2O$, which has been prepared previously, but in a different manner, by Nordenskjöld (*Ber.*, 1901, 34, 1572), were produced instead of the expected double chloride. It was found that the same green crystals could be prepared by the action of potassium amalgam on a solution of molybdic acid in hydrochloric acid, if the potassium was added in smaller quantity than is necessary for the production of the red double chloride, and also that the green salt could be converted into the red salt by reducing its hydrochloric acid solution with potassium amalgam.

155. "The action of benzamidine on olefinic β-diketones." By S. Ruhemann.

The author showed that hydrogen chloride reacts with a mixture of *m*-nitrobenzaldehyde and a β-diketone to form a *m*-nitrobenzylidenediketone, instead of giving rise to the additive product. Thus, *m*-nitrobenzaldehyde and acetylacetone furnish *m*-nitrobenzylideneacetylacetone, $CAc_2{:}CH{\cdot}C_6H_4{\cdot}NO_2$, melting at 101—102°. The yield of *m*-nitrobenzylidenebenzoylacetone, $PhCO{\cdot}CAc{:}CH{\cdot}C_6H_4{\cdot}NO_2$ (m. p. 111—112°), is very small owing to the ease with which it is decomposed by acids. One of the products of the decomposition which has been isolated is *m*-nitrobenzylideneacetophenone, $COPh{\cdot}CH{:}CH{\cdot}C_6H_4{\cdot}NO_2$ (m. p. 145°).

m-Nitrobenzylidene-β-diketones are also produced by the action of piperidine on the dry mixture of the aldehyde and the diketone. But in alcoholic solution, the saturated tetraketone is formed, such as *m*-nitrobenzylidenebisbenzoylacetone, $NO_2{\cdot}C_6H_4{\cdot}CH(CAc{\cdot}COPh)_2$ (m. p. 229—230°).

Benzamidine reacts with benzylidenebenzoylacetone,

$$PhCO{\cdot}CAc{:}CH{\cdot}Ph,$$

at the ordinary temperature to form an additive compound (m. p. 132°), the constitution of which is $NH{:}CPh{\cdot}NH{\cdot}CPh(OH){\cdot}CAc{:}CHPh$, because the compound is decomposed by dilute hydrochloric acid, giving rise to dibenzamide. Similar additive products with benzamidine are formed from the other olefinic β-diketones; these, however, are changed when their alcoholic solutions are heated on the water-bath. Thus,

sodium ethoxide and benzylideneacetylacetone react with benzamidine at 100° as follows: $CAc_2{:}CHPh + CPh(NH_2){:}NH + C_2H_6O = C_{17}H_{16}N_2 + MeCO_2Et + H_2O$.

The compound, $C_{17}H_{16}N_2$ (m. p. 149—150°), is most probably dihydrodiphenylmethylpyrimidine, $CHMe\langle\begin{matrix}CH{:}CPh\\N{=}CPh\end{matrix}\rangle NH$.

Benzamidine and *m*-nitrobenzylideneacetylacetone interact differently, since *m*-nitrophenylphenylmethylpyrimidine,

$$N\langle\begin{matrix}CPh{-}N\\CMe{\cdot}CH\end{matrix}\rangle C{\cdot}C_6H_4{\cdot}NO_2$$

(m. p. 137—138°), is formed, instead of the corresponding dihydropyrimidine. The olefinic monoketone, benzylidenedesoxybenzoin, $COPh{\cdot}CPh{:}CHPh$, does not condense with benzamidine, and the action of hydrogen chloride on the mixture of *m*-nitrobenzaldehyde and desoxybenzoin proceeds in the same way as when benzaldehyde is used, and yields $COPh{\cdot}CHPh{\cdot}CHCl{\cdot}C_6H_4{\cdot}NO_2$ (m. p. 166—167°).

156. "Dissociation constants of trimethylenecarboxylic acids." By W. A. Bone and C. H. G. Sprankling.

In connection with the work on methylenedimethylsuccinic acid, it became necessary to determine the dissociation constants of some trimethylenedicarboxylic acids, since no data with respect to them were available. The following numbers were obtained:

	$K_{25°}$.		$K_{25°}$.
Trimethylenecarboxylic acid	0·00171	*cis*-Trimethylene-1:2-dicarboxylic acid ...	0·042
Trimethylene-1:1-dicarboxylic acid ...	2·08	*trans*-Trimethylene-1:2-dicarboxylic acid	0·0215

A comparison of these values with those of the corresponding open chain saturated acids containing two additional hydrogen atoms indicates that the formation of a trimethylene ring increases the constant, this effect being particularly noticeable in the succinic series.

157. "The elimination of hydrogen bromide from bromo-*gem*-dimethylsuccinic acid and from bromotrimethylsuccinic anhydride." By W. A. Bone and H. Henstock.

Bromo-gem-dimethylsuccinic acid (m. p. 140°) is readily prepared by heating *gem*-dimethylsuccinic acid with the calculated quantity of dry bromine in sealed tubes at 130—140°; when heated with redistilled diethyl aniline at 130°, carbon dioxide is freely evolved, hydrogen bromide is eliminated, and *aaa*$_1$*a*$_1$-*tetramethyldihydromuconic acid* is

formed in the following manner: $2CO_2H\cdot CMe_2\cdot CHBr\cdot CO_2H = CO_2H\cdot CMe_2\cdot CH{:}CH\cdot CMe_2\cdot CO_2H + 2HBr + 2CO_2$. The new acid is obtained in well-defined, transparent, prismatic forms melting at 70°; it is extremely soluble in the ordinary organic solvents with the exception of light petroleum; its aqueous solutions immediately decolorise alkaline permanganate with formation of the *dihydroxy-acid*, $CO_2H\cdot CMe_2\cdot CH(OH)\cdot CH(OH)\cdot CMe_2\cdot CO_2H$, which melts at 129—130°. The dissociation constant of the tetrahydromuconic acid is $K_{25°} = 0{\cdot}001684$. The acid distils unchanged under the ordinary pressure, but when boiled with acetic anhydride it yields its own liquid anhydride.

In view of Paolini's observation (*Gazzetta*, 1900, **30**, ii, 497) that ethyl dimethyltrimethylenedicarboxylate is the product of the action of phosphorus pentachloride upon ethyl hydroxytrimethylsuccinate, the authors have repeated the work of Bone and Sprankling on the action of diethylaniline on bromotrimethylsuccinic anhydride (*Trans.*, 1902, **81**, 50), and by a study of the physical properties of the resultant acid, $C_7H_{10}O_4$, have fully confirmed the previous conclusion that it is *methylenedimethylsuccinic acid*, $CH_2{:}C(CO_2H)\cdot CMe_2\cdot CO_2H$. This acid melts at 142°, has a dissociation constant, $K_{25°} = 0{\cdot}01597$, and gives an insoluble calcium salt. Determinations of the refractive power and magnetic rotation of diethyl methylenedimethylsuccinate, made by Dr. W. H. Perkin, sen., fully support the argument in favour of the unsaturated character as against the "trimethylene" configuration of the foregoing acid.

ADDITIONS TO THE LIBRARY.

I. *Donations.*

Hellot, Jean. Färbekunst oder Unterricht, Wolle und wollene Zeuge zu färben; nebst Vorschriften wegen der Prüfungen durch Absieden. Aus dem französischen übersetzt von Abraham Gotthelf Kästner. Zwente Auflage, welcher eine Nachricht von der Seidenfärberen. Altenburg 1765.

From Major-General J. Waterhouse, I.S.C.

Holleman, A. F. Textbook of Organic Chemistry, translated from the second Dutch edition by A. J. Walker, assisted by O. E. Mott. New York 1903.

From the Publishers,

Meyer, Dr. H. Determination of Radicles in Carbon Compounds. Authorised translation by J. Bishop Tingle. 2nd edition. ill. New York 1903. From the Translator.

II. *By Purchase.*

Abegg, R. Die Theorie der elektrolytischen Dissociation. Stuttgart 1903.

Aschan, Ossian. Die Konstitution des Kamphers und seiner wichtigsten Derivate. Braunschweig 1903.

Baccioni, G. B. Dall 'Alchimia alla Chimica. Torino 1903.

Crookes, W. On the manufacture of beetroot sugar in England and Ireland. ill. London 1870.

Deutschen Landwirtschafts-Gesellschaft Arbeiten.

Heft 80. Die Düngung mit schwefelsaurem Ammoniak und organischen Stickstoffdüngern im Vergleich zum Chilisalpeter. Berlin 1903.

—— Heft 81. Untersuchungen über den Wert des neuen 40 prozent. Kalidüngesalzes gegenüber dem Kainit. Berlin 1903.

Ferchland, P. Grundriss der reinen und angewandten Elektrochemie. ill. Halle 1903.

Fischer, E. Synthesen in der Purin- und Zuckergruppe. Braunschweig 1903.

Garola, C. V. Engrais. Paris 1903.

Gauss, Carl Friederich. Allgemeine Grundlagen einer Theorie der Gestalt von Flüssigkeiten im Zustand des Gleichgewichts. Uebersetzt von R. H. Weber. Hrsg. von H. Weber (Ostwald's *Klassiker*, No. 135.) Leipzig 1903.

Grandeau, Louis. Valeur et rôle alimentaires du sucre chez l'homme et chez les animaux. Paris 1903.

Guldberg, C. M. Thermodynamische Abhandlungen über Molekulartheorie und chemische Gleichgewichte 1867—1872. Übersetzt und hrsg. von R. Abegg. (Ostwald's *Klassiker*, No. 139.) Leipzig 1903.

Haller, Albin. Les industries chimiques et pharmaceutiques. 2 Tome. ill. Paris 1903.

Hassack, P. Gärungs-Essig. ill. Wien 1904.

Horstmann, A. Abhandlungen zur Thermodynamik chemischer Vorgänge. Hrsg. von J. H. van't Hoff (Ostwald's *Klassiker*, No. 137.) Leipzig 1903.

Jünemann, Friedrich. Die Brikett-Industrie und die Brennmaterialien. Wien 1903.

König, J. Chemie der menschlichen Nahrungs-und Genussmittel. Vol. I, Chemische Zusammensetzung der menschlichen Nahrungs-und

Genussmittel. Nach vorhandenen Analysen mit Angabe der Quellen zusammengestellt. 4 Aufl. Hrsg. von A. Bömer. Berlin 1903.

Labonne, Henry. Formulaire pratique des parfums et des fards. ill, Paris 1903.

Lodge, Oliver. Modern Views on Matter. (Romanes Lecture 1903.) Oxford 1903.

Mahler, P. Études sur les combustibles solides, liquides et gazeux. ill. Paris 1903.

Meunier, Louis, and Vaney, Clement. La tannerie. Etude, préparation et essai des matières premières, théorie et pratique des différentes méthodes actuelles de tannage, examen des produits fabriqués, publié sous la direction de Léo Vignon. ill. Paris 1903.

Ostwald, W. Scientific foundations of analytical chemistry, treated in an elementary manner. Translated by George M'Gowan. London 1900.

Pairault, E. A. Le rhum et sa fabrication. ill. Paris 1903.

Seubert, Karl. Internationale Atomgewichte von 1903. Leipzig 1903.

Whetham, William Cecil Dampier. A treatise on the theory of solution, including the phenomena of electrolysis. Cambridge 1902.

Wiener, F. Die Weissgerberei, Sämischgerberei und Pergament-Fabrikation. ill. Wien 1904.

Winteler, F. Die Aluminium-Industrie. Braunschweig 1903.

Wohltmann, Dr. F. Chilisalpeter oder Ammoniak? Berlin 1903.

III. *Pamphlets.*

Dyer, Bernard, and Shrivell, F. W. E. The manuring of market garden crops. (*From the Journal of the Royal Horticultural Society*, 27, 1903.)

Fairley, T. On writing and printing inks. (*From the Journal of the Society of Dyers and Colourists, July*, 1903.)

Golding, John. Experiments on peas in water culture. (*From the Centralblatt f. Bakteriologie Abt. II., XI.*)

Liversidge, A. The Boogaldi, Barratta Nos. 2 and 3, Gilgoin Nos. 1 and 2, and Eli Elwah or Hay Meteorites, New South Wales. (*From the Journal and Proceedings of the Royal Society of N.S. Wales, Vol.* 36.)

Taylor, R. L. I, On a higher oxide of cobalt. II, A method for the volumetric determination of cobalt. (*From the Memoirs and Proceedings of the Manchester Literary and Philosophical Society*, 47, 1902—1903.)

Thwaite, B. H. The effect of flue dust upon the thermal efficiency

of hot-blast stoves. (*From the Journal of the Iron and Steel Institute*, 1903, I.)

Vines, S. H. Proteolytic enzymes in plants (II). (*From the Annals of Botany*, XVII, 1903.)

RESEARCH FUND.

A Meeting of the Research Fund Committee will be held in December. Applications for grants, to be made on forms which can be obtained from the Assistant Secretary, must be received on or before December 7th.

At the next meeting, on **Thursday**, December 3rd, 1903, at 8 p.m., there will be a ballot for the election of Fellows, and the following papers will be communicated :—

"On the molecular formulæ of some fused salts as determined by their molecular surface energy." By J. F. Bottomley.

"Acid salts of monobasic acids." By R. C. Farmer.

"The atmospheric corrosion of zinc." By G. T. Moody.

"The solubilities of the hydrates of nickel sulphate." By B. D. Steele and F. M. G. Johnson.

CERTIFICATES OF CANDIDATES FOR ELECTION AT THE NEXT BALLOT.

N.B.—The names of those who sign from "General Knowledge" are printed in *italics*.

The following Candidates have been proposed for election. A ballot will be held on Thursday, December 3rd, 1903.

Abell, Robert Duncombe,
Bradwall, Sandbach, Cheshire.

Assistant Lecturer and Demonstrator in Chemistry in the University College of North Wales, Bangor. Studied in Bangor. "Diploma in Agriculture," 1894; "Diploma in Agricultural Chemistry," 1895; B.Sc. (Wales) with First Class Honours in Chemistry, 1899; Associate of Institute of Chemistry, 1899; 1851 Exhibition Scholar, 1899–1902; Ph.D. (Leipzig) and D.Sc. (Wales), 1902; F.I.C., 1903. "The Condensation of Phenyl ethyl ketone and Benzaldehyde," *Trans.*, 1901, 79, 928. "The Condensation of Phenyl ethyl ketone with Benzylideneacetophenone and of Acetophenone with Benzylidenepropiophenone," *Trans.*, 1903, 83, 360. "A Synthesis of 1 : 3 : 5-triphenyl-2 : 4-dimethyl*cyclo*pentane and of 1 : 3 : 5-triphenyl-2-methyl*cyclo*pentane," *Trans.*, 83, 367.

James J. Dobbie. William A. Bone.
H. B. Dixon. D. L. Chapman.
W. H. Perkin, jun. Kennedy J. P. Orton.
Alexander Lauder.

Appleyard, Percy,
Albany, Western Australia.

Pharmaceutical Chemist. Chemist. Interested in Assay work, and desirous of keeping in touch with Chemical Investigation.

F. W. Richardson. T. Donald Watson.
E. J. Millard. *B. E. R. Newlands.*
John C. Hewlett. *Peter MacEwan.*
Thos. Tyrer.

Armstrong, Edward Frankland,

55, Granville Park, Lewisham, S.E.

Salters' Research Fellow, Central Technical College. Ph.D. Berlin. Author of papers in the "Sitzungsberichte der Akademie der Wissenschaft zu Berlin" and the "Berichte der Deutschen Chemischen Gesellschaft," in conjunction with either Prof. van 't Hoff or Prof. E. Fischer.

Henry E. Armstrong.	Percy F. Frankland.
Emil Fischer.	W. Palmer Wynne.
J. H. van 't Hoff.	Gerald T. Moody.

Ashdown, Herbert Henry,

3, Genesta Road, Plumstead.

Analytical Chemist and Metallurgist. Eleven years Assistant in the Laboratory of H. H. Smith, Esq., F.I.C., Royal Laboratory Department, Royal Arsenal, Woolwich. Four years Demonstrator to R. J. Redding, Esq., in Chemistry and Metallurgy at the Royal Arsenal Mechanics Institute. Honours in Chemistry, Metallurgy, and Iron and Steel Manufacture.

R. J. Redding.	F. Mollwo Perkin.
A. Lapworth.	Lionel M. Jones.

Chas. R. Darling.

Attwell, Herbert Moore,

Hill House, Limpley Stoke, Bath.

Student of Royal College of Science (Lond.). Student for three years at above College, and Associate of the Royal College of Science (A.R.C.S.).

James C. Philip.	William A. Tilden.
Chapman Jones.	G. T. Morgan.
M. O. Forster.	M. White Stevens.

Badcock, William Cornish,

The Grammar School, Crediton, Devon.

Science Master in the above school. Studied Chemistry for 3 years at Cambridge, B.A. 1st Class Nat. Sci. Tripos Pt. I. 1900. Desires admission to the Society in order that he may keep in touch with recent work in Chemistry.

M. M. Pattison Muir.	R. S. Morrell.
S. Ruhemann.	E. K. Hanson.

H. J. H. Fenton.

Bailey, Harold James,

40, The Avenue, Pontypridd, South Wales.

Chemist to the Great Western Coll. Co. Coke Works and Bye-product Plant. 4½ years Chemistry Student University College, Sheffield. 2 years Chief Assistant to F. G. Treharne, Esq., F.C.S., Consulting and Analytical Chemist, Cardiff. Chemist at present to Bye-product Recovery Plant at Coke Works (above).

F. Gmlyn Treharne. William H. Oates.
George Young. Henry Annable.
W. Carleton Williams.

Barker, Thomas Vipond,

Exeter College, Oxford.

Undergraduate; will take Chemistry Schools in June, 1904. Done research work in Chemical Crystallography for nine months under Prof. Groth in Munich; part of the results already published in the current "Zeit. für. Kryst." s. 275.

Henry A. Miers. H. L. Bowman.
W. W. Fisher. J. E. Marsh.
John Watts.

Beadnell, Charles Marsh,

H.M.S. *Barracouta*, Capetown and West Coast.

Staff Surgeon, Royal Navy. Anxious to obtain the Proceedings of the Society and use of Library.

Chas. E. Beadnell. Thos. Stevenson.
Charles E. Groves. *H. C. H. Carpenter.*
E. A. Tyler.

Bayly, Harold Goodenough,

"Moatside," Bedford.

Analytical Chemist. Associate of the Institute of Chemistry. Student in the Laboratory of Alfred Jörgensen of Copenhagen, Oct—December, 1902. Now Chemist to Messrs. Batey & Co., Mineral Water Manufacturers.

John M. Thomson. D. Northall Laurie.
Herbert Jackson. Alfred H. Allen.
Patrick H. Kirkaldy. Fredk. J. Lloyd,
Gilbert J. Alderton.

Beam, William, M.A., M.D.,
Pension Sima, Cairo, Egypt.

Chief Chemist to the Egyptian Salt & Soda Co. Formerly Chief Chemist to the Baltimore and Ohio Railway in America. Joint Author, with Dr. Henry Leffmann, of the following works: (1) Progressive Exercises in Practical Chemistry; (2) Examination of Water for Sanitary and Technical Purposes; (3) Analysis of Milk and Milk Products; (4) Select Methods in Food Analysis (No. 4 Published by Rebman, London), Blakeston, Philadelphia.

Otto Hehner.	*John Golding.*
Wm. Chattaway.	*Arthur R. Ling.*
H. Droop Richmond.	*Edward Bevan.*

Bliss, Henry James Wheeler,
Balliol College, Oxford.

Student. Studied under Rev. T. C. Porter, Eton College, and 3 years at Balliol College.

T. C. Porter.	H. B. Hartley.
R. Tabor Lattey.	*Henry E. Roscoe.*
D. H. Nagel.	*William Crookes.*

Bluman, Nicholas John,
10, Amersham Road, New Cross, S.E.

Works Chemist. Day student for 3 years under Dr. F. Mollwo Perkin in the Borough Polytechnic Laboratories, and assistant in Practical Chemistry Classes during the session 1902–3.

F. Mollwo Perkin.	John E. Mackenzie.
Edwin C. Jee.	*J. T. Hewitt.*
Bertram Blount.	*O. J. Steinhart.*

Brühl, Paul,
Engineering College, Sibpur, near Calcutta.

Professor of Physics, Mineralogy, and Geology, Engineering College, Sibpur. Lecturer on Chemistry, Rajshahye College, 1882–1887. Professor of Physics and Chemistry, Engineering College, Sibpur, 1887-1895. Professor of Physics, Geology and Mineralogy, 1896 to the present time.

William Tate.	Prafulla Chandra Ray.
David Hooper.	Walter T. Grice.

H. E. Stapleton.

Buggé, Erasmus Robert,

327, Grove Green Road, Leytonstone.

Chemist. Student in Chemistry 1895 and 1896 under Dr. Hewitt. Holder of various certificates from the Science and Art Dept., S.K. Engaged at the Chemical Works of Messrs. Walter Voss & Co., Millwall, for 9 years, and has there done a considerable amount of analytical and research work, and is now desirous of being privileged to attend the meetings of the Society and to enjoy the benefit of the Society's Literature and Library.

Alfred C. Young.	Isaac S. Scarf.
Walter A. Voss.	J. T. Hewitt.

Charles E. Sohn.

Clacker, William,

Bryantwood, Auckland Road, Ilford.

Analytical Chemist. From 1892 to present time. Chemist with Henry Tate and Sons, Ltd., Silvertown, Sugar Refiners. Studied Chemistry under Dr. Hewitt at the East London Technical College, and obtained 1st Class at the London Matriculation.

J. Woodward.	Hugh Main.
J. T. Hewitt.	D. Bendix.
Albert Harrison.	*B. E. R. Newlands.*

Deeks, William Thomas,

High St., Shanklin, I. of W.

Pharmaceutical Chemist. Interested in the Bacteriology of Fermentation.

Frank Oram.	J. Brierley.
Harry Wilson.	*Robert Wright.*

Walter S. Crocker.

Derwent, Ernest,

36, Sixth and Railroad, Ironton, Ohio, U.S.A.

Analytical Chemist. 12 years' experience in Analysis of Iron and Steel, Refractory Material, etc. Chief Chemist to Union Iron and Steel Co., Ironton, Ohio, U.S.A.

J. E. Stead.	*C. H. Ridsdale.*
H. Frankland.	*John Pattinson.*
E. H. Saniter.	*J. T. Dunn.*

Ellis, Henry Russel,

177, Warwick Road, W.

Science Teacher. Inter. B.Sc. London [Working for Honours

Chemistry at Final B.Sc.]. Teacher of Chemistry at Regent Street Polytechnic. Wishes to become a Member to obtain the advantages of the meetings and the Journal, and to keep in touch with modern chemical advances.

Frank E. Weston. J. Bernard Coleman.
J. C. Crocker. *O. Loewenthal.*

R. W. Sindall.

Fawsitt, Charles Edward,

9, Foremount Ter., Glasgow, W.

Demonstrator in Chemistry, University of Edinburgh. Am engaged in original research in physical chemistry. Published work in *Zeitschrift für Physikal. Chemie*, 1902. Member of the Society of Chemical Industry, the Faraday Society, the German Chemical Society, ex-1851 Exhibition Scholar, Ph.D., B.Sc., author of "Tables for Students of Quantitative Chemical Analysis" (Clay, 1903).

Alex. Crum Brown. Leonard Dobbin.
James J. Dobbie. Morris W. Travers.
James Walker. Alexander Lauder.

Forster, William,

6, North Railway Street, Seaham Harbour.

Pharmaceutical Chemist. Formerly a student under Mr. Wm. Fowler, F.C.S., Sunderland, and Mr. Wm. Duncan, F.C.S., Royal Dispensary, Edinburgh; and at the Pharmaceutical Society's School, Bloomsbury Square.

William Fowler. J. Norman Collie.
William Duncan. Arthur Lapworth.

T. E. Wallis.

Friend, John Albert Newton,

2, Francis Road, Watford, Herts.

Science Master at Watford Grammar School. B.Sc. (Honours Chemistry) Birmingham University, 1902. M.Sc. (for Research on the Reaction between Caro's acid and H_2O_2) Birmingham University, 1903. Priestley Research Scholar at Birmingham University (from 1902—3). Late Assistant Demonstrator at University, Birmingham (1901—2).

Percy F. Frankland. Alex. Findlay.
Alex. McKenzie. T. Slater Price.

Thomas Turner.

Gardiner, Ernest Alexander,
Bretherton, Nr. Preston Lancs.

Teacher. B.A. Keble College, Oxford. 1st Class in Final Honour School of Chemistry (June 1903). Senior Science Master at the Plymouth and Mannamead College. Engaged in Research Work on Inorganic Chemistry.

W. W. Fisher. J. E. Marsh.
John Watts. Allan F. Walden.
H. L. Bowman.

Gatehouse, Frank Brooks,
56, Windmill Street, Gravesend, Kent.

Demonstrator in Chemistry and Metallurgy. Assistant analytical chemist. Two years in laboratory under J. W. Gatehouse, F.I.C., Public Analyst for Bath, &c. Four and a half years as student-demonstrator at the Merchant Venturers' Technical Coll. Bristol, under Prof. J. Wertheimer, B.Sc., F.I.C., F.C.S.; Associate of the Merchant Venturers' Technical Coll., Bristol, and Assistant Chemist to the "Associated Portland Cement Manufacturers, Ltd., Gravesend and London." Author of "Process for estimation of Cyanide in the presence of a Chloride" (*Chem. News*, Oct. 25, 1901). Has passed Honours Part II. inorganic and organic Chemistry, and Hons. Pt. I. Metallurgy, Brd. of Ed. practical examinations.

J. Wertheimer. Arnold Philip.
G. P. Darnell Smith. *F. Wallis Stoddart.*
A. E. Thomas. *Ernest H. Cook.*

Gent, Percy William,
792½, Ridge Street, Newark, N. J., U.S.A.

Metallurgical Chemist. Student for three years at University College, London, under Sir William Ramsay, K.C.B., F.R.S.; also at Royal College of Science, S. Kensington. Assistant Chemist with Dr. Paul Jeserich, Gerichts-Chemicker of Charlottenburg, Berlin, and afterwards with Messrs. Morris & Co., Metal Extractors, Doncaster. Now metallurgical chemist with the Balbach Smelting and Refining Co., Newark, N. J., U.S.A.

William Ramsay. Otto Hehner.
Edward C. Cyril Baly. Allan T. Hall.
Thomas Gough. Morris W. Travers.

Grundy, Frank Barnes,
Red Lodge, King's Road, Richmond, S.W.

Technical Chemist. Three years' Chemical Training, University

College, Victoria University. Assistant to Professor Lewes four years. Eight years Assistant Chemist Welsbach Incandescent Co.; now Manager and Chemist, Ramie Co., Bredbury, Stockport.

Vivian B. Lewes. James Swinburne.
J. S. S. Brame. W. R. Cooper.
Charles A. Kohn. W. Mackean.
Horatio Ballantyne.

Hall, John T.,
West View, Stanwell, Staines.

Manager and Analyst for the Staines Sewage Works, Stanwell. I am a Member of the Sanitary Institute (by Exam.); I am the author of a paper on Sewage Works Management and Analytical Chemistry for Sewage Works Managers, read before a Meeting of the Sewage Works Managers Assoc., July 18th, 1903.

James Ashton. *W. Watson Will.*
Samuel Rideal. *A. Wynter Blyth.*
Henry Kenwood. *A. W. Gerrard.*

Heasman, Harold Montague,
1, Carlisle Road, Finsbury Park, N.

Analytical Chemist. Studied Science at University College under Sir William Ramsay and Prof. Carey-Foster. Studied Metallurgy under C. J. Head, Esq., F.C.S., F.I.C., and at King's College and the Birkbeck Institution. Have been acting as Assistant Chemist for the past four years to Messrs. Stanger and Blount, 2, Broadway, Westminster, where I am still engaged.

S. Dickson. C. J. Head.
Bertram Blount. A. M. Kellas.
John E. Mackenzie.

Hendrickson, Arthur V.,
The Gasworks, Lower Sydenham, S.E.

Analytical and Gasworks Chemist. Chemist to the Crystal Palace District Gas Company, Lower Sydenham, for past 2 years.

Robert English. *Vivian B. Lewes.*
Samuel Rideal. *W. W. Duffield.*
H. F. Hills. *F. Napier Sutton.*

Howarth, John George,
"Danes Dyke," Capstone Road, Bournemouth.

Senior Science Master, Bournemouth School. Teacher of Chemistry and Physics (Registered under the Board of Education), for the last

eight years, at the Crypt Grammar School, Gloucester, and the Bournemouth School (School of Science).

George Embrey. B. S. Gott.
W. H. Edwards. *J. M. Collett.*
J. S. S. Brame.

Hughes, Edwin Reginald,
106, Queen Victoria St., London, E.C.

Analytical and Metallurgical Chemist. Formerly five years assistant to Mr. Edward Riley. 15 years Chemist to South Wales Steel Works, Llanelly, now practising at above address.

George H. Hughes. B. E. R. Newlands.
John Hughes. E. W. Voelcker.
Bernard Dyer. Thos. Howard.

Hymans, Herbert,
13 and 14, Trinity Sq., E.C.

Manufacturing Chemist (Pharmaceutical and Technical Chemicals and Drugs). Formerly student in the Laboratories of the City of London College under Mr. I. S. Scarf, F.C.S. Pupil Assistant (18 months) in Laboratory of Samuel Rideal, Esq., D.Sc., F.I.C., F.C.S. Assistant (3½ years) in Analytical Laboratory of Messrs. Wright, Layman and Umney, Manufacturing Chemists, London. *Notes*, etc., published:—"New Method for Estimation of Phenols" (Pharmaceutical Journal); "The Occurrence of Sodium Sulphate in Nature" (Pharmaceutical Journal, 1900).

Samuel Rideal. Henry Durham.
Ernest J. Parry. Isaac S. Scarf.
J. Wicliffe Peck.

Ibbotson, Edward Charles,
3, Ashgate Road, Sheffield.

Works Manager, Sybry, Searls, & Co., Ltd., Sheffield. Mappin Medallist (Metallurgy). Associate Sheffield University. (4 years) Managing Chemist, The Aruba Island Gold Mining Co., Ltd., Dutch West Indies.

Fredk. J. Merrils. Alfred H. Allen.
Lawrence Dufty. *G. T. W. Newsholme.*
Harry Brearley.

Jackson, William Henry,
73, Church Street, West Hartlepool.

Analytical Chemist. Three years as Articled Pupil and three years as Assistant to Mr. A. C. Wilson, F.R.S.E., District Agricultural

Analyst to the Co. of Durham. Two years as Chemist to the West Yorkshire Iron and Coal Co., Ltd., &c., and during the last four years have been engaged in private practice as Analytical and Consulting Chemist.

A. C. Wilson. Thomas Fairley.
J. Falconer King. George Siddle.
F. W. Richardson.

Jennings, Walter Ernest,
8, Rawdon Terrace, Ashby-de-la-Zouch.

Schoolmaster. Certificated in Honours in Chemistry by the Board of Education. Teacher of Chemistry at Ald. Newton's School, Leicester, for 9 years. Headmaster of the English Department of the Grammar Foundation, Ashby-de-la-Zouch.

W. W. Tunnicliffe. W. Ball.
Fredk. Cowling. *S. I. Crookes.*
C. O'Sullivan.

Kent, Thomas Oliver,
89, Loughboro' Park, Brixton, S.W.

Analytical and Research Chemist. Managing Chemist of the Research Laboratories of Messrs. Oppenheimer, Son, & Co., Ltd. Original work done on the physiological action of the Iron Salts. Am desirous of possessing the literature of the Chemical Society, and keeping in touch with chemical progress.

W. Shepperson. Alan Fletcher.
H. Helbing. A. Searl.
J. T. Ainslie Walker. *C. F. Cross.*
Edward Bevan.

Kielty, John J.,
71, Cairo Road, Walthamstow.

Teacher of Chemistry in the Walthamstow Technical School, Science School A. (1) Teacher of Chemistry for 16 years; (2) 1st Class Honours Practical Chemistry; 1st Class Advanced Theory of Chemistry; 1st Class Advanced Organic Theory; 1st Class Advanced Practical Organic, S.K.; (3) Certificated Teacher and qualified Teacher of Physics and Mathematics.

Jos. S. Bridges. Chapman Jones.
C. A. Buckmaster. James C. Philip.
Isaac S. Scarf.

Knight, Harley Fancutt,
"Ledbury," 64, Amhurst Park, Stamford Hill, N.
Analytical Chemist, Assistant to Bertram Blount, Esq. Certificated student of the Chem. Depart., City of London Guilds Technical College, Finsbury, E.C.

R. Meldola. F. Southerden.
John Castell-Evans. Chas. R. Darling.
Bertram Blount.

Laing, John, F.I.C.,
Everlie, Skelmorlie, N.B.
Analytical Chemist. Papers on Destructive and Conservative Distillations of Mineral Oils and their molecular condition. Keith Medal, Royal Scottish Society of Arts, Edinburgh (printed in their transactions). Oil Gas before Society of Chemical Industry (printed in their transactions). Late Chemist and Works Manager, Midlothian Oil Company, Ltd., Straiton, Midlothian. Late General and Commercial Manager, Boson Oil Company, Ltd., near Fréjus, Var. France.

Stevenson Macadam. George Beilby.
John Hunter. *J. Falconer King.*
J. Stanley Muir.

Lamplough, Francis Edward Everard,
Trinity College, Cambridge.
Student. 1st Class Nat. Sci. Tripos, 1902. Major Scholar of Trinity College. Exhibitioner in Chemistry, London Intermediate Science, 1903.

G. D. Liveing. H. J. H. Fenton.
W. J. Sell. H. O. Jones.
J. P. Millington.

Lawrence, Henry William,
Wellington, New Zealand.
Analytical Chemist. Chief Assistant, Chemical Laboratory—Agricultural Department, Wellington, N.Z. Formerly assistant to Dr. Voelcker, Royal Agricultural Society's Laboratory, and to Sir Henry Gilbert, Rothamsted Laboratory (10 years). Now with Mr. B. C. Aston, Chemist of Agric. Dept. Wellington, N.Z.

J. Augustus Voelcker. Harry M. Frecar.
Thos. Howard. E. W. Voelcker.
Bernard Dyer.

Leadbetter, Harold Duff,

95, Capel Road, Forest Gate, London, E.

Assistant Demonstrator at the Royal College of Science, London. Associate of the Royal College of Science, London. Assistant Chemist for 3 years at Messrs. A. Boake, Roberts and Co., Ltd., London, E.

William A. Tilden. G. T. Morgan.
M. O. Forster. H. Burrows.
J. C. Philip.

Le Bas, Gervaise,

Baymont House, St. Aubin's, Jersey.

Science Teacher. B.Sc. London University. Received Chemical Training University College, London. Formerly Science Master, Kingswood School, Bath. At present Science Master, County Intermediate School, Llanelly.

William Ramsay. Edward C. Cyril Baly.
Morris W. Travers. W. Lester Alton.
A. Vincent Elsden.

Macdonald, David Baird,

18, Kimberley Road, Leicester.

Chemist and Laboratory Manager. Studied Chemistry under Dr. David Lees, Glasgow; passed the Pharmaceutical Society's Minor Exam. 1896; gained Kinninmont Gold Medal (Electricity, Magnetism and Botany, 1896); spent 4 years in Pharmaceutical Laboratory, J. F. Macfarlan and Co., Edinburgh, under D. B. Dott, Esq., F.I.C., F.R.S.E., &c.; Studied Essential Oils under W. Watson Will, Esq., Metropolitan Coll. Pharmacy, London; late Chemist to Messrs. Dakin Brothers, Middlesex Street, London, E.C.; now Chemist and Manager to E. H. Butler and Sons, Manufacturing Chemists, New Haymarket, Leicester.

W. Watson Will. Harold E. Burgess.
F. Filmer De Morgan. Peter MacEwan.
Ernest J. Parry. Thos. Tyrer.

McMahon, Frederick William,

61, Brockley Rise, Forest Hill, S.E.

Works Chemist. I received my training as an analytical chemist at St. Thomas's Hospital. First as a student (three years) and then as lecture assistant (four years) under Professor Wyndham R. Dunstan. At present engaged as works chemist to Oxychlorides, Ltd., doing research work.

Wyndham R. Dunstan. Hamilton Wingate.
Arthur W. Crossley. *W. Carrick Anderson.*
H. R. Le Sueur. *James Roberts, Jr.*

Mann, Ernest William,

"Lynton," Willow Avenue, Edgbaston, Birmingham.

Analyst and Chemist to Messrs. Southall Bros. and Barclay, Manuf. Chemists, Birmingham. Apprenticed to the above firm in analytical laboratory for 4 years, assistant chemist 7 years, now chief. Pharmaceutical Chemist. Co-author with the late John Barclay, B.Sc., in a paper on the investigation of Benzoin and allied drugs (*Pharmaceutical Journal*, Mar. 15, 1902). Contributed a paper on the adulterations and methods of detection of Copaiba (*Pharmaceutical Journal*, Mar. 21, 1903).

Alfred Southall. C. G. Moor.
Frank H. Alcock. Geo. E. Perry.
Robert H. Pickard. *A. W. Gerrard.*

Monier-Williams, Gordon Wickham,

The Lammas, Esher, Surrey.

B.A. Oxon. First Class, Honour School of Natural Science, Oxford, 1903. Now a Student in the University of Freiburg.

V. H. Veley. W. W. Fisher.
H. E. Roscoe. J. E. Marsh.
Wm. Odling. *James Dewar.*
William Ramsay.

Nairne, Urban Orlando Scotchburn,

7, Hawthorne Terrace, Ripple Road, Barking, Essex.

Analytical Chemist. Have been for the last five years Assistant to H. Leicester Greville, F.I.C., F.C.S., Chemist to the Commercial Gas Company, and am a First Class Matriculated Student of the London University, and Chemist to the Wandsworth and Putney Gas Co.

H. Leicester Greville. *W. J. Dibdin.*
D. A. Sutherland. *Robt. G. Grimwood.*
H. F. Hills. *W. J. A. Butterfield.*

Nevin, James Victor,

Bristol Dispensary, Bristol.

Pharmacist. I have been engaged in Analytical work for over two years in the Chemical Laboratory, Swindon. Since 1898 have been Pharmacist in charge of the Bristol Dispensary; during that time have had a considerable amount of Analytical work to do.

Ernest H. Cook. Wm. Berry.
Frederic R. Ellis. *G. P. Darnell-Smith.*
John C. Umney.

Parry, William,

23, Mount Pleasant, Waterloo, Liverpool.

Schoolmaster. B.Sc. (London University, Mathematics and Chemistry). Teacher of Chemistry in Merchant Taylors' School, Crosby.

W. Ross Innes.	Prosper H. Marsden.
Henry C. Bond.	J. W. Shepherd.

Francis Jones.

Pike, Henry George,

Downton, Salisbury, Wilts.

Demonstrator in Practical Chemistry at the College of Agriculture, Downton. For 20 years Assistant to Dr. Munro. Professor of Chemistry at the College of Agriculture, Downton, Wilts. For 10 years, Demonstrator of Practical Chemistry, Qualitative Analyses, and Quantitative Analyses of Fertilisers, Feeding Stuffs, Waters, Soils, Milk and other Dairy products, &c., at the College of Agriculture.

John M. H. Munro.	John Wrightson.
Alfred J. Wilcox.	*C. H. Corbett.*
F. O. Solomon.	*Bernard Dyer.*

Plymen, George Horace Gladstone,

2, Melton Road, Leicester.

Science teacher in Organised Science School. Government recognised and registered teacher of science (including chemistry) in secondary schools. Six years' experience as student in chemical laboratories; the experience includes work in Honours Stage (South Kensington), and the work laid down in the B.Sc. (Lond.) syllabus. Inter. B.Sc. London University (1900).

William Ball.	*F. W. Toms.*
Edward Masters.	*A. D. Hall.*
W. W. Tunnicliffe.	*E. J. Russell.*
William T. Boone.	*Albert Howard.*
Lewis Ough.	*M. J. R. Dunstan.*

Pollard, William Branch,

68, Finnart Street, Greenock, N.B.

Analytical Chemist B.A. (Cantab.). Second Class Natural Science Tripos, 1901. Technical research on the cause of frothing in boiling sugar solutions.

W. J. Sell.	H. J. H. Fenton.
Sidney Skinner.	William C. T. Beasley.

H. O. Jones.

Redfern, Herbert Stanley, B.Sc.,
U.M.F.C. College, Ningpo, China.

Principal and Lecturer in Science. Took the course prescribed for the Victoria B.Sc. degree in the Honours School of Chemistry at Owens College, Manchester (1899—1900), and Yorkshire College, Leeds (1900—1902). Graduated June, 1902; since which has taken a post-graduate course at Yorkshire College in General and Technical Organic Analysis. Has recently been appointed Principal of the U.M.F.C. College at Ningpo, China, and his duties will include the teaching of Chemistry and Physics. Desirous of having the Society's publications in order to keep himself informed of current investigations.

H. B. Dixon. Norman Smith.
D. L. Chapman. Julius B. Cohen.
Wm. A. Bone. *W. H. Perkin, jun.*

Rich, Stiles William George,
Stanley Street, South Brisbane, Queensland.

Pharmaceutical Chemist. Ten years' experience as Pharmaceutical Chemist, during which time was four years Assistant to A. B. Chater, Esq, F.C.S. (present Public Analyst for Brisbane), and two years as Lecturer at College of Pharmacy, Brisbane.

J. Brownlie Henderson. Horatio Ballantyne.
Arthur B. Chater. J. West Knights.
T. H. W. Idris.

Richardson, Harold Ernest,
63, Lansdowne Road, Seven Kings, Ilford.

Science Master at Coopers' Company's School. Bachelor of Arts and Bachelor of Science (London University).

J. T. Hewitt. W. H. C. Jemmett.
J. McCrae. A. E. Dunstan.
Harold A. Auden.

Rogers, William David,
36, Grange Road, Smethwick.

Assistant in the Chemical Laboratory, Clifton College, Bristol. Associate of the Royal College of Science for Chemistry. Been engaged in teaching Chemistry for several years under W. A. Shenstone and F. T. S. Houghton, King Edward's School, Five Ways, Birmingham.

W. A. Shenstone. M. O. Forster.
William A. Tilden. G. T. Morgan.
G. M. Norman.

Senter, George,

37, Ronalds Road, Highbury, London, N.

Teacher of Chemistry. Sir John Cass Technical Institute, Aldgate, London, E.C. Ph.D. (Leipzig). B.Sc. (Lond.). Pharmaceutical Chemist. Studied Chemistry at Pharm. Society's School; University College, London; Universities of Leipzig and Göttingen; late 1851 Exhibition Research Scholar. *Published Papers*: "Das H_2O_2-Zersetzende Enzym des Blutes" (*Zeit. Phys. Chem.*, 1903, 44, 257); 1903 "Density of Colloidal Solutions" (with Sir W. Ramsay, K.C.B.), *B. A. Report*, 1901; "Measurement of Temperature" (with Dr. Travers and Dr. Jacquerod), (*Phil. Trans.*, 1902, *A.*, p. 105).

William Ramsay.	Edward C. Cyril Baly.
Charles A. Kohn.	Samuel Smiles.
Morris W. Travers.	*J. Norman Collie.*

Slator, Arthur,

The Priory, Burton-on-Trent.

Demonstrator and Lecturer at University College, Nottingham, having the following degrees: Ph.D. (Leipzig), M.Sc. (Birmingham), B.Sc. (London), and having contributed a paper on "The Chemical Dynamics of the Reactions between Chlorine and Benzene" to the *J. Chem. Soc.*, 1903, 83, 729.

F. Stanley Kipping.	T Slater Price.
Percy F. Frankland	R. M. Caven.

Henry J. S. Sand.

Smith, Frank Gurney,

7, Luxemburg Gardens, Brook Green, W.

Chemical Student. Diploma of Associate of City and Guilds Institute (1902). Since October, 1902, have been engaged in Research work under the direction of Dr. Armstrong at the Central Technical College.

Henry E. Armstrong.	William A. Davis.
Gerald T. Moody.	William Robertson.
T. Martin Lowry.	Edward W. Lewis.

Smith, William Veysey,

7, Grove Road, Ipswich Road, Norwich.

One of His Majesty's Inspectors of Factories under the Home Office. Formerly Postmaster in Natural Science (Chemistry) at Merton College, Oxford. Second Class Final Honour School of Chemistry,

Oxford. B.A. I have held a Science Mastership at Cranbrook School, Kent, and Blundell's School, Tiverton.

W. W. Fisher. V. H. Veley.
John Watts. *Allan F. Walden.*
J. E. Marsh. *H. L. Bowman.*

Stewart, Alfred Walter,

18, Annfield Terrace, Partick Hill, Glasgow.

Student. Bachelor of Science, Glasgow University, 1902; was appointed Research Student in Chemistry, 1901; spent a winter semester in Germany on Research work, 1902–3; was appointed to an 1851 Exhibition Scholarship (1903).

John Ferguson. James Roberts, jun.
W. Carrick Anderson. Matthew A. Parker.
D. R. Boyd.

Tighe, Arthur,

20, Marlborough Place, St. John's Wood.

Chemical Student. Student under Basil Turner, Esq., Assayer of Sydney, N.S.Wales (eighteen months). Lecturer, Sydney University. Student under A. C. Chapman, Esq., F.I.C., of Duke St., Aldgate, E.C. (twelve months). Also at Finsbury College for one course.

Alfred C. Chapman. F. Southerden.
R. Meldola. F. Guy Stirling Baker.
Fredk. J. Harry.

Turner, Arnold,

316, Entwisle Rd., Rochdale.

Brewer and Chemist. A Student in the Brewing Section of Chemical Department, Manchester School of Technology for three years. Obtained first place in Honours and the Silver Medal in Brewing, of City and Guilds, London, 1903. Desirous of obtaining the Society's Journal for purposes of study.

William J. Pope. S. J. Peachey.
Jas. Grant. L. G. Radcliffe.
F. S. Sinnatt.

Turner, William Ernest Stephen,

52, Cheshire Road, Smethwick.

Science Teacher. Science Instructor to the Oldbury Higher Education Committee. Birmingham University Research Scholar. B.Sc. (London).

Percy F. Frankland. Alex. Findlay.
Alex. McKenzie. T. Slater Price.
R. Lloyd Whiteley.

Walker-Pole, Miles,

71, De Korle Street, Braamfontein, Johannesburg.

Analytical and General Chemist. Registered as a Chemist and Druggist under the Pharmaceutical Society of Great Britain, October 7, 1893. Granted Diploma by the "Raad van Examinatoren," Pretoria, March 17, 1896, for special mining analytical report. Chemical work under Stevenson Macadam, Edin., 1891. Eight years' practical experience Gold Assay and General Mining Chemistry. Assay work under Dr. Muter, Kennington, 1894. Experiments in Amalgamation, resulting in the production of a metal for mining pumps which stands the action of the Rand water better than that in use before.

John Muter. John C. Hewlett.
E. J. Millard. *Peter MacEwan.*
R. L. Jenks.

Weiss, Carl Friederich Richard,

37, Binfield Road, Clapham, London, S.W.

Formerly Analytical Chemist (Assistant of Prof. Dr. Migula, Karlsruhe, Bad.), now Pharmaceutical Chemist. Studied Chemistry at Berlin University, 2 years; Bacteriology at Karlsruhe Polytechnic, 1 year; Bacteriology and Chemistry at Bâle University, 1 year. Ph.D., M.A., Bâle University. Diploma as German Apotheker, Berlin University; M.Ph.S., London. Author of "Ueber die Bacterienflora der sauren Gährung einiger Nahrungs und Genussmittel," 1899.

Otto Hehner. H. Helbing.
Oscar Guttmann. *Arthur R. Ling.*
B. E. R. Newlands.

Wright, Fred,

Terry Street, Balmain, N.S.W.

Chemist. Lecturer in Pharmacy, Materia Medica, and Pharmaceutical Chemistry, Technical College, Sydney, 1882—1902. Pharmaceutical Chemist to Elliott Bros. (Limited), Manufacturing Chemists, Balmain, Sydney, N.S.W.

Henry G. Smith. Will. A. Dixon.
William M. Hamlet. *W. M. Doherty.*
Andrew J. Dixon.

The following were recommended by the Council for presentation to ballot under Bye-Law I. (3):

Kin, Thein,

Rangoon.

Assistant to the Chemical Examiner, Burma. Studied Chemistry in the Rangoon College. B.A., Calcutta University, 1895. First Assistant to the Lecturer in Chemistry and Physical Science, Rangoon College, 1896—1901. Assistant to the Chemical Examiner, Burma, from April, 1901.

M. Hunter. *Andrew Campbell.*

Prasad, Mata,

Beni lal's Katra, Benares City.

Merchant and Honorary Lecturer in Chemistry. M.A. First Class Allahabad University, late Professor Physical Science Bareilly College, at present Honorary Professor and Lecturer of Chemistry Central Hindu College, Benares.

Arthur Richardson. *Sydney Young.*

Abhayacharan Sanyal. *Francis G. Francis.*

Robertson, Philip Wilfred,

20, Talavera Terrace, Wellington, New Zealand.

Student. Author of "Atomic and Molecular Heats of Fusion," T., 1233, P., 1902, 131. Sir George Grey Scholar in Physics and Chemistry at Victoria College. At present engaged in research in Organic and Physical Chemistry under Professor Easterfield.

Thomas H. Easterfield. J. S. Maclaurin.

R. CLAY AND SONS LTD., BREAD ST. HILL, E.C., AND BUNGAY SUFFOLK.

Issued 11/12/03

PROCEEDINGS

OF THE

CHEMICAL SOCIETY.

Vol. 19. No. 272.

Thursday, December 3rd, 1903. Professor W. A. TILDEN, D.Sc., F.R.S., President, in the Chair.

Messrs. M. Kemp-Welch and J. T. Ainslie Walker were formally admitted Fellows of the Society.

Certificates were read for the first time in favour of Messrs.

Alfred Denys Cowper, 3, Bishop's Mansions, Fulham, S.W.
Nevil Norton Evans, McGill University, Montreal, Canada.
John Monteath Guthrie, 199, Ferry Road, Leith, N.B.

The PRESIDENT announced that since the last meeting a photograph of the portrait of Roger Bacon which is in Knole House, had been presented to the Society by Mr. Oscar Guttmann.

A ballot for the election of Fellows was held, and the following were subsequently declared duly elected:

Robert Duncombe Abell, Ph.D., D.Sc.
Percy Appleyard.
Edward F. Armstrong, Ph.D.
Herbert Henry Ashdown.
Herbert Moore Attwell.
William Cornish Badcock, B.A.
Harold James Bailey.
Thomas Vipond Barker.
Harold Goodenough Bayly.
Charles Marsh Beadnell.
William Beam, M.A., M.D.
Henry James Wheeler Bliss.
Nicholas John Bluman.
Paul Brühl.

Erasmus Robert Buggé.
William Clacher.
William Thomas Deeks.
Ernest Derwent.
Henry Russel Ellis.
Charles E. Fawsitt, Ph.D., B.Sc.
William Forster.
John Albert N. Friend, M.Sc.
Ernest A. Gardiner, B.A.
Frank Brooks Gatehouse.
Percy William Gent.
Frank Barnes Grundy.
John T. Hall.
Harold Montague Heasman.
Arthur V. Hendrickson.
John George Howarth.
Edwin Reginald Hughes.
Herbert Hymans.
Edward Charles Ibbotson.
William Henry Jackson.
Walter Ernest Jennings.
Thomas Oliver Kent.
John J. Kielty.
Thein Kin, B.A.
Harley Fancutt Knight.
John Laing.
Francis E. E. Lamplough, B.A.
Henry William Lawrence.
Harold Duff Leadbetter.
Gervaise Le Bas, B.Sc.
David Baird Macdonald.
Frederick William McMahon.
Ernest William Mann.
Gordon W. Monier-Williams, B.A.
Urban Orlando S. Nairne.
James Victor Nevin.
William Parry, B.Sc.
Henry George Pike.
George Horace G. Plymen.
William Branch Pollard, B.A.
Mata Prasad, M.A.
Herbert Stanley Redfern, B.Sc.
Stiles William George Rich.
Harold E. Richardson, B.A., B.Sc.
Philip Wilfred Robertson.
William David Rogers.
George Senter, Ph.D., B.Sc.
Arthur Slator, Ph.D., M.Sc.
Frank Gurney Smith.
William Veysey Smith, B.A.
Alfred Walter Stewart, B.Sc.
Arthur Tighe.
Arnold Turner.
William Ernest S. Turner, B.Sc.
Miles Walker-Pole.
Carl Friederich R. Weiss, Ph.D.
Fred Wright.

***158. "The molecular formulæ of some fused salts as determined by their molecular surface energy." By J. F. Bottomley.**

The electrolytic conductivity of fused salts has not been satisfactorily explained, but it might be expected that ionisation would be produced by the presence of complex molecules, and, at Sir William Ramsay's suggestion, measurements of the variation of the capillary rise with temperature were undertaken with the object of testing this point. The determinations with lithium and silver nitrates, potassium chlorate and dichromate, zinc and stannous chlorides were unsatisfactory owing to experimental difficulties, and successful results were obtained only with sodium and potassium nitrates. The average value of K for sodium nitrate is 0·503, and for potassium nitrate, 0·445, instead of 2·12, the normal value for non-associating substances. This implies that 9 or 10 molecules of the simple salt, $NaNO_3$ or KNO_3, are associated to form a complex, the supposition that a portion of the salt is ionised by the complex molecules of another portion being therefore rendered probable.

***159. "The atmospheric corrosion of zinc." By G. T. Moody.**

The recorded observation that hydrogen peroxide may be detected during the oxidation of zinc in presence of water has been brought forward by Dunstan in support of his contention that, in the case of iron, hydrogen peroxide "is a necessary intermediate product of the chemical change involved in rusting" (Report of the Steel Rails Committee of the Board of Trade, 1900; this vol., p. 152). It consequently appeared of interest to determine if the scale formed during the atmospheric corrosion of zinc showed a composition which would justify the assumption that it is to be regarded as an oxidation product formed by the interaction of metal, water, and oxygen. To this end, strips of thin sheet zinc were suspended in a muslin bag under the shelter of a north wall and exposed to the full effects of the atmosphere for 5 months. At the end of this period, the semi-crystalline scale was detached from the metal and dried; it had a composition closely agreeing with the formula $ZnCO_3,3Zn(OH)_2$. The production of this basic carbonate may be regarded as evidence that the atmospheric corrosion of zinc is to be attributed not to direct oxidation of metal, but to an interaction with carbonic acid. This view is supported by the behaviour of zinc in a saturated solution of carbon dioxide. The metal dissolves with evolution of hydrogen and formation of zinc hydrogen carbonate. The resulting solution, when heated or exposed to air, becomes turbid and on spontaneous evaporation yields a basic carbonate agreeing in composition with the product of atmospheric corrosion.

Whilst zinc is rapidly converted into hydroxide by commercial hydrogen peroxide, this metal like iron remains practically unattacked when in contact with pure 30 per cent. peroxide. The statement made by Dunstan (*loc. cit.*) that iron, zinc, and lead behave similarly towards hydrogen peroxide is not in agreement with the observations of the author, who finds that the addition of a few milligrams of assay lead induces immediate decomposition of 30 per cent. peroxide, oxygen and steam escaping with almost explosive violence. The lead becomes superficially coated with brown peroxide and presents an appearance quite different to that arising from atmospheric corrosion.

The author concludes that the atmospheric corrosion of zinc, like that of iron, is the result of interaction between metal and acid, and that the attack on zinc is less marked because the acid is in a great measure retained in combination as basic carbonate.

***160. "The formation of urea by the direct hydrolysis of lead cyanate." By A. C. Cumming.**

Lead cyanate is readily and quantitatively transformed into lead carbonate and urea by direct hydrolysis with boiling water: $Pb(CNO)_2 + 2H_2O = PbCO_3 + CON_2H_4$. This salt, which is prepared by adding lead nitrate to potassium cyanate solution from which the carbonate has previously been removed by barium nitrate, is fairly stable at the ordinary temperature and may be washed with cold water until free from impurities.

The progress of the change was followed qualitatively with a polarising microscope, advantage being taken of the fact that the small acicular crystals of lead cyanate which polarise light are gradually replaced by amorphous granules of lead carbonate.

The action was also followed quantitatively by a titration method which depends on the fact that lead cyanate neutralises twice as much acid as the products of its hydrolysis.

No evidence was obtained of the formation of ammonium cyanate, and this method is therefore distinct from any earlier synthesis.

Discussion.

The President expressed surprise that this reaction had not already been observed, remembering the use of lead cyanate in a process introduced many years ago by the late Mr. John Williams for the manufacture of urea (*J. Chem. Soc.*, 1868, 21, 63).

161. "Acid salts of monobasic acids." By R. C. Farmer.

The substituted benzoic acids have the general property of forming salts containing one molecule of the free acid to one molecule of neutral salt. The potassium and ammonium salts were taken as typical, and the acid salts of benzoic acid and its methyl, hydroxy-, bromo-, and nitro-derivatives were examined. These substances form well-defined, crystalline compounds, which do not undergo any change at the melting points of the free acids; they are not affected by inert solvents, but are at once decomposed by water. Experiments on the ratio of distribution of the acids between benzene and aqueous solutions of their normal salts showed that these acid salts do not exist to any appreciable extent in aqueous solution. In alcohol, on the other hand, the dissociation is only partial, as was shown by molecular weight determinations at the boiling point.

162. "The solubility curves of the hydrates of nickel sulphate." By B. D. Steele and F. M. G. Johnson.

The solubilities of the hydrates of nickel sulphate have been determined at temperatures ranging from $-5°$ to 99°, and equilibrium curves have been constructed for the following hydrates: $NiSO_4,7H_2O$, $NiSO_4,6H_2O$ (blue quadratic), and $NiSO_4,6H_2O$ (green monoclinic). A fourth hydrate is deposited from saturated solutions at temperatures above 118°, and the salt separating at 131° has been analysed and found to be the dihydrate, $NiSO_4,2H_2O$.

The following quadruple points have been fixed: (1) the cryohydrate point of the heptahydrate ($-4{\cdot}15°$). (2) The transition point (31·5°): $NiSO_4,7H_2O \rightleftarrows NiSO_4,6H_2O$ (blue) + saturated solution. (3) The transition point (53·3°): $NiSO_4,6H_2O$ (blue quadratic) $\rightleftarrows NiSO_4,6H_2O$ (green monoclinic). The transition point of the change: $NiSO_4,6H_2O \rightleftarrows NiSO_4,2H_2O$ + saturated solution, has not been determined.

163. "Action of malt diastase on potato starch paste." By B. F. Davis and A. R. Ling.

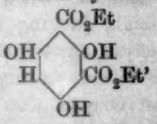
In continuing their earlier experiments (*J. Fed. Inst. Brewing*, 1902, 8, 475), the authors show that a solution of diastase, when heated above 55°, becomes weaker in its action and that the alteration produced in the enzyme molecule is a permanent one, for the diastase retains its acquired properties when it is reprecipitated from its solution by alcohol and allowed to act on starch paste at or below 55°. The altered diastase produces *d*-glucose when it acts on starch paste, and the change appears to commence when a solution of the enzyme is heated below 60°, although, judging from the small amount of *d*-glucose produced, the reaction is not complete at this temperature. As the temperature of the initial heating is raised, the amount of *d*-glucose produced by the enzyme also increases, the maximum amount being obtained by the action of diastase, which has been previously heated in solution at 68—70° for fifteen to thirty minutes. Above this temperature, the destruction of the enzyme is so rapid that a much larger proportion has to be employed to attain that stage of the reaction at which *d*-glucose appears. Nevertheless, *d*-glucose is formed by diastase which has been heated to 78°, and probably at even higher temperatures. It has been observed in all cases that when the solution is kept at the temperature of hydrolysis (usually 55°) after the maximum amount of *d*-glucose has been formed, the amount of this sugar present diminishes, and the occurrence of this apparent condensing action of the enzyme may

probably in several cases explain the failure to detect *d*-glucose among the products of hydrolysis. The maximum amount of *d*-glucose formed in any case does not exceed about 12 per cent. of the total hydrolytic products.

164. "The formation of phloroglucinol by the interaction of ethyl malonate with its sodium derivative." By C. W. Moore.

In the year 1885, Baeyer made the important discovery that when ethyl malonate is heated with its sodium derivative at 145°, a derivative of phloroglucinol is formed, which melts at 104°, and which Baeyer considered was ethyl phloroglucinoltricarboxylate, $C_6(OH)_3(CO_2Et)_3$ (*Ber.*, 1885, 18, 3457).

During the course of an investigation involving the use of ethyl malonate, the author was led to reinvestigate this matter, and he has been able to prove that the substance formed under the conditions employed by Baeyer is ethyl phloroglucinoldicarboxylate, $C_6H(OH)_3(CO_2Et)_2$, and not the above-mentioned tricarboxylate. The molecular weight determination in benzene solution gave 273 and 270, whereas the molecular weights of the dicarboxylic and tricarboxylic esters are 270 and 342 respectively. The determination of the ethoxyl groups, which was carried out by Dr. W. H. Perkin, sen., also gave numbers which clearly show that the substance is a dicarboxylic ester. When treated with bromine, it yields a bromide having the composition $C_6Br(OH)_3(CO_2Et)_2$, which was first prepared by Bally (*Ber.*, 1888, 21, 1770). Since it also yields a triacetyl compound when heated with acetic anhydride, there can scarcely be a doubt that Baeyer's ester must be represented by the formula



and that it is therefore *ethyl phloroglucinoldicarboxylate*.

ADDITIONS TO THE LIBRARY.

I. *Donations.*

Bloxam, Charles Loudon. Chemistry, inorganic and organic. With experiments. 9th edition. By John Millar Thomson and Arthur G. Bloxam. pp. xii + 872. ill. London 1903. From the Publishers.

Bolton, Henry Carrington. Contributions of alchemy to numismatics. pp. 44. ill. New York 1890. From the Author.

Browning, Philip E. Introduction to the rarer elements. pp. viii + 158. New York 1903. From the Publishers.

Clough, W. T., and Dunstan, A. E. Elementary experimental science. pp. 239. ill. London 1904. From the Authors.

Clowes, Frank, and Coleman, J. Bernard. Elementary practical chemistry. Part I. General chemistry. 4th edition. pp. xvi + 198. ill. London 1903. From the Publishers.

Duhem, P. Thermodynamics and chemistry. A non-mathematical treatise for chemists and students of chemistry. Authorized translation by G. K. Burgess. pp. xxii + 445. ill. New York 1903. From the Publishers.

Elbs, Karl. Electrolytic preparations. Exercises for use in the laboratory by chemists and electro-chemists. Translated by R. S. Hutton. pp. 100. ill. London 1903. From the Translator.

Ellis, C. Sordes. Elementary chemistry of photographic chemicals. pp. 120. ill. London 1903. From the Author.

Henry, T. A. Aids to chemistry. pp. 316. London 1903. From the Author.

Hoff, J. H. van't. Physical chemistry in the service of the sciences. English version by A. Smith. pp. xviii + 126. ill. Chicago 1903. From the Publishers.

Landolt, Hans. Assisted by Schönrock, O., Lindner, P., Schütt, F., Berndt, L., and Posner, T. The optical rotating power of organic substances, and its practical applications. Authorized translation with additions by J. H. Long. pp. xxii + 752. ill. Easton, Pa. 1902. From the Publishers.

Lassar-Cohn. The praxis of urinary analysis. A guide to the chemical analysis of urine. With directions for preparing artificial pathological urines for practicing the various tests, and an appendix on the analysis of stomach contents. Authorized translation by H. W. F. Lorenz. pp. vi + 58. New York 1903. From the Publishers.

Mathias, E. Le point critique des corps purs. pp. viii + 255. ill. Paris 1904. From the Author.

Sorel, Emile. La grande industrie chimique minérale. pp. 679. ill. Paris 1904. From the Author.

Wright, Charles Romley Alder. Animal and vegetable fixed oils, fats, butters, and waxes: their preparation and properties, and the manufacture therefrom of candles, soaps, and other products. 2nd edition, edited and partly rewritten by C. Ainsworth Mitchell. pp. xvi + 804. ill. London 1903. From the Publishers.

II. *By Purchase.*

Hausbrand, E. Die Wirkungsweise der Rektifizier-und Destillier-Apparate mit Hilfe einfacher mathematischer Betrachtungen. 2 Aufl. pp. 114. ill. Berlin 1903.

Heermann, Paul. Koloristische und textilchemische Untersuchungen. pp. 398. ill. Berlin 1903.

Hoyer, Egbert, und Kreuter, Franz. Technologisches Wörterbuch. Band I. Deutsch-Englisch-Französisch. Band II. Englisch-Deutsch-Französisch. Band III. Französisch-Deutsch-Englisch. 5 Aufl. pp. 884, 877, 790. Wiesbaden 1902—1904.

At the next ordinary meeting on **Wednesday**, December 16th, 1903, at 5.30 p.m., the following papers will be communicated:—

"The relative strengths of the fixed bases and ammonia as measured by their action on cotarnine." By J. J. Dobbie, A. Lauder, and C. K. Tinkler.

"New halogen derivatives of diphenyl and dihydroxydiphenyl." By J. C. Cain.

"Constitution of nitric peroxide." By E. Divers.

"Sabatier's nitrosodisulphonic acid." By E. Divers.

"Notes on some natural colouring matters." By A. G. Perkin and E. Phipps.

"The estimation of methyl alcohol in presence of ethyl alcohol." By T. E. Thorpe and J. Holmes.

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Issued 31/12/03

PROCEEDINGS

OF THE

CHEMICAL SOCIETY.

Vol. 19. No. 273.

Wednesday, December 16th, 1903. Professor W. A. TILDEN, D.Sc., F.R.S., President, in the Chair.

Messrs. E. F. Armstrong, H. J. W. Bliss, E. R. Hughes, B. Ingram, and C. Müller were formally admitted Fellows of the Society.

Certificates were read for the first time in favour of Messrs.

Alick Cole Benson, 33, Perham Road, West Kensington.
Robert Gawler, M.Sc., 3, South View Terrace, Leeds.
Leo Frank Guttmann, Ph.D., 18, Aberdare Gardens, N.W.
Cyril Douglas McCourt, 52, Victoria Road, Clapham, S.W,
Benjamin L. Murray, 19, University Place, New York.
Thomas Stewart Patterson, Ph.D., Lyddon Hall, Leeds.
Alfred Shrubsole, 91, Holyhead Road, Coventry.
Samuel John Smith, 41, Grafton Street, Dublin.
Alfred Tingle, Ph.D., B.Sc., Shantung, China.

Of the following papers, those marked * were read:

*165. "The relative strengths of the alkaline hydroxides and of ammonia as measured by their action on cotarnine." By J. J. Dobbie, A. Lauder, and C. K. Tinkler.

The authors have shown (Trans., 1903, 83, 598) that in aqueous solution, cotarnine has the "ammonium hydroxide" form, whereas in ethereal or chloroform solution it exists as a "carbinol."

These two forms are distinguished by having widely different and very characteristic absorption spectra (*loc. cit.*, Plate I, carbinol form; Plate II, ammonium hydroxide form).

When cotarnine in aqueous solution is acted on by sodium hydroxide or any other soluble base, it is converted into the carbinol form. The proportion of the cotarnine which undergoes this change depends on the amount of sodium hydroxide present, the change being practically complete when a milligram-molecule of cotarnine is dissolved in one litre of normal sodium hydroxide solution. After the addition of any given quantity of sodium hydroxide, a state of equilibrium is established almost instantaneously, and no further change takes place in moderately dilute solutions, even after several hours, provided that the temperature is kept constant. Each additional quantity of sodium hydroxide causes a further transformation of "ammonium hydroxide" into "carbinol" form. This change can be followed through all its phases by photographing the spectra of the solution after each addition of sodium hydroxide, the spectra obtained being in reality those of mixtures of the two modifications (*loc. cit.*, Plate III, Figs. 17—24), the relative amounts of which can be determined by comparing these photographs with a standard series obtained by photographing the spectra of solutions prepared by mixing the two forms of cotarnine in definite proportions. It is possible, therefore, to estimate the amount of change which any given quantity of sodium hydroxide produces in an aqueous solution of cotarnine, and to obtain a curve representing the effect of successive additions of the alkali.

The action of ammonia and of the hydroxides of lithium, sodium, potassium, barium, and calcium has been examined in this way. The curves for the first three hydroxides are nearly identical, from which it is inferred that, so far as their action on cotarnine is concerned, they have practically the same strength; those of the last two agree with one another but differ slightly from the others, indicating a slight inferiority of strength, especially for the more concentrated solutions.

The curve for ammonia, which differs widely from those of the alkaline hydroxides, indicates that this base is much weaker than the latter substances.

Discussion.

Mr. W. C. Reynolds expressed the hope that Prof. Dobbie would be able to investigate, in this connection, the parent bases, hydrastine and narcotine, from which hydrastinine and cotarnine are derived by oxidation. In the case of hydrastine, he had noticed the existence of two modifications, one variety melting at about 131—132° and the other at

a temperature somewhat above 140°. If either variety was dissolved in alcohol or acetone and the solvent removed at the temperature of the water-bath, the less fusible variety was obtained; but if the solution was allowed to evaporate spontaneously, or if a concentrated hot solution was cooled and then allowed to crystallise, the more fusible variety was obtained. The less fusible variety was always produced by the fractional precipitation by ammonia of the hydrastine salts.

Moreover, if the temperature when in the neighbourhood of the melting point was raised very slowly (about 1° per half hour), the crystals appeared to change from the more fusible to the less fusible modification. The crystals which melted at 131—132°, when heated in the ordinary manner, did not soften until the temperature was considerably above 140°, and then melted somewhat indefinitely.

Under similar conditions, both varieties seemed to have the same specific rotation in solution.

Similar changes were not observed in the case of the allied alkaloid, narcotine.

***166. "Peroxylaminesulphonates and hydroxylaminetrisulphonates (sulphazilates and metasulphazilates)." By T. Haga.**

By oxidising potassium hydroxylaminedisulphonate, Fremy obtained the salts which he called sulphazilate and metasulphazilate. Claus re-named the former "oxysulphazotate," and formulated its constitution as $(SO_3K)_2N\langle\begin{smallmatrix}O\\ \\ O\end{smallmatrix}\rangle N(SO_3K)$; the latter he called "trioxyazoate," giving it the formula $O{:}N(SO_3K)_3,H_2O$. Raschig changed these formulæ into $(SO_3K)_2N\langle\begin{smallmatrix}O\\ \\ O\end{smallmatrix}\rangle N(SO_3K)_2$ and

$$(SO_3K)_2N\langle\begin{smallmatrix}O\\ \\ O\end{smallmatrix}\rangle N(SO_3K)_2,2H_2O$$

whilst Hantzsch and Semple have re-named the sulphazilate "nitroxydisulphonate" with the formula, $O{\cdot}N{:}(SO_3K)_2$, and have gone back to Claus's formula for the metasulphazilate.

The author has found that (1) potassium sulphazilate interacts with normal potassium sulphite, $(SO_3K)_2NO{\cdot}ON(SO_3K)_2 + K{\cdot}SO_3K = (SO_3K)_2NOK + (SO_3K)ON(SO_3K)_2$, to form normal potassium hydroxylaminedisulphonate and potassium metasulphazilate; (2) the sulphazilate decomposes spontaneously into the metasulphazilate, hydroxylaminedisulphonate, and much nitrous acid, the last being preserved as nitrite when potassium hydroxide is present: $2(SO_3K)_4N_2O_2 + H_2O = 2(SO_3K)_2NO + (SO_3K)_2NOH + NO_2H$; (3) potassium metasulphazilate

is decomposed quantitatively into sulphate and normal aminedisulphonate (iminosulphate) by sodium amalgam or by the zinc-copper couple, $KO{\cdot}SO_2{\cdot}O{\cdot}N(SO_3K)_2 + 2Na = KO{\cdot}SO_2{\cdot}ONa + NaN(SO_3K)_2$; and (4) the ultimate products of its hydrolysis, when heated with hydrochloric acid, are hydroxylamine and sulphuric acid.

The molecular magnitude of sodium hydroxylaminetrisulphonate and also of the 2/3-normal sodium hydroxylaminedisulphonate, as determined by Loewenherz's method, is in each case that which contains only one atom of nitrogen. The constitution of the sulphazilates is therefore that expressed by the name, potassium peroxylaminesulphonate, and the formula, $(SO_3K)_2NO{\cdot}ON(SO_3K)_2$, and of the metasulphazilates that expressed by the name and formula, potassium hydroxylaminetrisulphonate, $(SO_3K)_2N{\cdot}O{\cdot}(SO_3K)$. The sulphazilates are oxime peroxides or peroximes, being produced by oxidising hydroxylaminedisulphonates with a variety of reagents (including ozone), even in the cold; they behave as oxidising agents, becoming again reduced to hydroxylaminedisulphonates,

$$2(SO_3K)_2NOH \rightleftharpoons [(SO_3K)_2NO]_2.$$

A metasulphazilate is the only known case of a triacylated hydroxylamine. Having, as a hydroxylaminetrisulphonate, one of its sulphonate radicles in union with oxygen, it is clearly one-third sulphatic, yet without being actually a sulphate. It is a mixed oxide or anhydride of two acid salts, one being the acid sulphate and the other the 2/3 normal hydroxylaminedisulphonate,

$$(SO_3K)O\boxed{H + HO}N(SO_3K)_2.$$

The inorganic mixed anhydride most closely analogous to a hydroxylaminetrisulphonate is Pelouze's salt, potassium hyponitrososulphate, $(SO_3K){\cdot}O{\cdot}(N_2OK)$, the two salts agreeing in being stable in presence of caustic alkali and in not yielding barium sulphate with a soluble barium salt, whilst giving rise to a sulphate with sodium amalgam or zinc. To understand this behaviour, it is only necessary to assume that the metasulphazilate ionises into three metallic kations and a complex trivalent anion which includes within itself the sulphate radicle. Dunstan and Goulding have shown that zinc and acid reduce trialkylhydroxylamines to trialkylamines, so that if, as has hitherto been supposed, metasulphazilates were oxamines, they should reduce to aminetrisulphonates (nitrilosulphates) and not to aminedisulphonates and sulphates. The author concludes that the nitrogen of the sulphazilates and metasulphazilates is exclusively tri- and not quinquevalent, as suggested by the earlier investigators of these salts.

There is so much difference between the properties of a peroxylaminesulphonate and those of the bluish-violet substance produced by the action of sulphur dioxide on a solution of nitrososulphuric acid in

sulphuric acid that it is improbable that Sabatier's suggestion will prove correct as to the latter compound being the acid of Fremy's bluish-violet salt.

Potassium hydroxylaminetrisulphonate is shown to have 3/2 mols. of water of crystallisation, whereas Claus, who stated that the salt contained one mol. of water, was perhaps unaware that some of its water of crystallisation becomes fixed by hydrolysis during the drying. Sodium, ammonium, and hydroxy-lead hydroxylaminetrisulphonates have been prepared for the first time.

*167. "Peroxylaminesulphonic acid." By E. Divers.

In support of Sabatier's assumption that the bluish-violet colour caused by the action of sulphur dioxide on sulphuric acid containing nitrososulphuric acid is due to the formation of the unknown acid of Fremy's bluish-violet potassium salt (sulphazilate or peroxylaminesulphonate), it is pointed out that the difference in properties observed by Haga (preceding note) is hardly greater than that between the behaviour of nitrous acid in the respective forms of nitrososulphuric acid and potassium nitrite.

Sabatier's observations are shown to be quite consistent with the view that the acid is peroxylaminesulphonic acid, that is, a peroxide and a compound of trivalent nitrogen.

*168. "Constitution of nitric peroxide." By E. Divers.

Haga's examination of Fremy's *sulphazilate* has established that it is *peroxylaminesulphonate*, a trivalent nitrogen compound and a peroxide. It is a sulphonated nitric peroxide, as suggested by Hantzsch and Semple, and when decomposed by water, gives a complex anhydrosulphate (hydroxylaminetrisulphonate), on the one hand, and, on the other, nitrous acid and sulphonated nitrous acid (hydroxylaminedisulphonate), equivalent respectively to the nitric and nitrous acids which are yielded by nitric peroxide. Dinitric peroxide is therefore a true peroxide, *nitrosyl peroxide*, $(NO)_2O_2$.

Mononitric peroxide must therefore be regarded as O:N·O, formulated with a univalent oxygen atom, and not with its nitrogen atom in the quadrivalent condition, O:N:O, as suggested by Piloty and Schwerin (*Ber.*, 1901, **34**, 1884 and 2354). For it seems appropriate to consider the constitution of the two forms of nitric peroxide to be the same, the only difference being the presence in the one form of the bivalent double atom of oxygen, and in the other form of a single univalent oxygen atom. A true peroxide is correctly defined as a compound in which some or all of the oxygen is exerting on the rest of the com-

pound only half its usual valency. Piloty and Schwerin's *porphyrexide*, $(C_5H_9N_2)_2$:NO (*loc. cit.*), is to be regarded as being such a peroxide.

169. "Halogen derivatives of diphenyl and dihydroxydiphenyl." By J. C. Cain.

The author has already shown that only a small amount of 3 : 3′-dichloro-4 : 4′-dihydroxydiphenyl is obtained by boiling the corresponding diazonium salt with water (Trans., 1903, 83, 688), and now describes a method for preparing the substance by chlorinating 4 : 4′-dihydroxydiphenyl.

The following compounds are described: 3 : 3′-*dichlorodiphenyl*, white needles, m. p. 29°, b. p. 298°; 3 : 4 : 3′ : 4′-*tetrachlorodiphenyl*, white needles, m. p. 172°, b. p. 230° under 50 mm. pressure; 4 : 4′-*dibromo*-3 : 3′-*dichlorodiphenyl*, white needles, m. p. 176—177°; 4 : 4′-*diiodo*-3 : 3′-*dichlorodiphenyl*, pale yellow needles, m. p. 162°, b. p. 275° under 10 mm. pressure; 4 : 4′*dicyano*-3 : 3′-*dichlorodiphenyl*, white needles, m. p. 152—153°; 3 : 3′-*dichlorodiphenyl*-4 : 4-*dicarboxylic acid*, white needles, m. p. 287—288°. 3-*Chloro*-4 : 4′-*dihydroxydiphenyl*, white needles, m. p. 215°. 3 : 3′ : 5(?)-*Trichloro*-4 : 4′-*dihydroxydiphenyl*, white needles, m. p. 179°.

170. "Notes on some natural colouring matters." By A. G. Perkin and E. Phipps.

The flowers of the *Prunus spinosa* contain both quercetin and kampherol, whereas in the violet (*viola odorata*) and white clover (*trifolium repens*) quercetin alone has been detected. From the Japanese dyestuff "Fukugi" (botanical origin unknown), a new colouring matter, $C_{17}H_{12}O_6$, has been isolated, forming yellow, prismatic needles (m. p. 288—290°), the general properties of which indicate that it is closely allied to luteolin. On bromination, it yields the compound $C_{17}H_{10}O_6Br_2$ (yellow needles, m. p. 280°), and, when fused with caustic alkali, phloroglucinol and protocatechuic acid are obtained.

Morintetraethyl ether, $C_{15}H_6O_3(OEt)_4$ (yellow, prismatic needles, m. p. 126—128°), closely resembles the corresponding methyl derivative and forms the colourless acetyl compound, $C_{15}H_5O_3(OEt)_4 \cdot C_2H_3O$ (needles, m. p. 121—123°). When brominated in the presence of alcohol, myricetin yields a mixture of tetrabromomyricetin and *tetrabromomyricetin ethyl ether*, $C_{15}H_5Br_4O_7 \cdot OEt$ (colourless needles melting completely at 146°).

Cryoscopic determinations of the molecular weight of its acetyl derivative indicate that hesperitin has the formula $C_{16}H_{14}O_6$, and not

$C_{32}H_{28}O_{12}$, as previously suspected by the formation of the alkali salts, $C_{32}H_{27}O_{12}K$ and $C_{32}H_{27}O_{12}Na$ (Trans., 1898, 31, 1031). *Benzoylcurcumin* (yellow needles, m. p. 176—178°) in a similar manner gave results in harmony with Ciamician and Silber's formula, $C_{21}H_{20}O_6$, (*Ber.*, 1897, 30, 192) for curcumin.

171. "The estimation of methyl alcohol in presence of ethyl alcohol." By T. E. Thorpe and J. Holmes.

The authors described a method of estimating the amount of methyl alcohol in mixtures of methyl and ethyl alcohols based on the different modes of action of a mixture of potassium dichromate and sulphuric acid on the two alcohols. The method differs from that already described by Dupré, in 1876, in which the amount of acetic acid formed is taken as a measure of the amount of ethyl alcohol present, in that the amount of carbon dioxide evolved is weighed.

The authors described how their method is applicable to the case of the methylated spirit of commerce, and to the detection and determination of methylated spirit in tinctures and medicinal preparations suspected to contain it.

172. "Separation and estimation of silver cyanide and silver chloride." By R. H. A. Plimmer.

Freshly precipitated silver cyanide, although insoluble in cold dilute nitric acid, readily dissolves in the boiling acid, evolving the theoretical quantity of hydrogen cyanide, so that the gas, when passed into silver nitrate solution, produces an amount of silver cyanide equal in weight to the sample originally employed. In this way, silver cyanide may be quantitatively separated from silver chloride. When the cyanide has been dried at 100°, the hard lumps produced offer a greater resistance to the solvent, and if the boiling is prolonged the acid, on becoming more concentrated, oxidises a small proportion of the hydrogen cyanide.

173. "Estimation of hydroxyl radicles." By H. Hibbert and J. J. Sudborough.

In attempting to determine hydroxyl groups by Tschugaeff's method (*Ber.*, 1902, 35, 3912), the authors have not succeeded in obtaining satisfactory results, owing to the following causes: (1) moisture gradually penetrates through the india-rubber, even although this is coated with collodion. (2) The vapour pressure of ether varies so enormously with slight alterations of temperature. (3) Grignard's magnesium methyl iodide solution slowly absorbs atmospheric oxygen.

The following method is free from the foregoing objections; dry amyl ether is used as the medium instead of ordinary ether, and the operation is carried out in an ordinary bottle provided with a double bored india-rubber stopper, so that the bottle may be attached to (1) a Lunge's nitrometer filled with dry mercury, (2) a glass tube provided with a stopcock, so that the air in the apparatus may be replaced by dry nitrogen. The amyl ether solution of the hydroxyl compound is placed in the bottle and a solution of Grignard's magnesium methyl iodide in the same solvent is introduced in a small tube; when a constant temperature has been attained, the two solutions are mixed.

Satisfactory results have been obtained with α- and β-naphthols, resorcinol, *o*-nitrophenol, acetoxime, deoxybenzoin and chloral hydrate.

Quinol gives somewhat low results, probably owing to the fact that it is only sparingly soluble in amyl ether.

174. "Diortho-substituted benzoic acids. Part V. Formation of salts from diortho-substituted benzoic acids and organic bases." By J. J. Sudborough and W. Roberts.

Since the publication of Part IV (*Trans.*, 1899, **75**, 580), E. Fischer has shown (*Ber.*, 1900, **33**, 345, 1967) that diortho-substituted tertiary bases of the type of dimethylmesidine are incapable of forming quaternary ammonium salts. The authors have prepared several mono- and diortho-substituted tertiary amines, and find that these are capable of combining with strong diortho-substituted benzoic acids, for example, *s*-trinitrobenzoic and 2 : 4 : 6-tribromo-3-aminobenzoic acids, but will not unite with feeble acids like 2 : 4 : 6-trimethylbenzoic and *o*-toluic acids.

In addition to the ordinary normal salts (1 mol. acid + 1 mol. base), acid salts of the type (2 mols. acid + 1 mol. base) derived from monobasic acids and monoacidic bases have been obtained. Many of these salts can be analysed by direct titration in alcoholic solution with standard barium hydroxide solution, using phenolphthalein as the indicator.

175. "*cis*-π-Camphanates of *d*- and *l*-hydrindamines." By F. S. Kipping.

cis-π-Camphanic acid gives with *dl*-hydrindamine two isomeric salts melting at 173° and 193° respectively, but which have the same specific rotation in aqueous solution (Trans., 1900, **77**, 903).

Having recently succeeded in resolving the *dl*-base (*Trans.*, 1903, **83**, 873), the author examined the *cis*-π-camphanates of the *d*- and of the *l*-base, partly to prove that the compounds previously described

are really partially racemic, and partly to ascertain whether each of the optically active bases gives isomeric salts.

d-Hydrindamine *cis*-π-camphanate, obtained by combining the acid with the base from pure *d*-hydrindamine *d*-bromocamphorsulphonate, crystallises from water and alcohol in long needles and melts at about 181°; when fractionally crystallised from aqueous alcohol, the final mother liquors yield fractions which melt very indefinitely at 170—175°; the specific rotation of various fractions of this salt, examined in 2 per cent. methyl alcoholic solution, varied from $[\alpha]_D$ −7·8° to −17·8°.

l-Hydrindamine *cis*-π-camphanate, prepared from the base contained in pure *l*-hydrindamine *d*-bromocamphorsulphonate, closely resembles the salt of the *d*-base, but the original preparation melts indefinitely at 186—191°; when crystallised fractionally from aqueous alcohol, it yields portions melting as low as 180—184°. The specific rotation of fractions of this salt, determined in 2 per cent. methyl alcoholic solutions, varied from $[\alpha]_D$ −6° to +7°.

These observations seem to justify the conclusion that each base gives two isomeric salts, which, when the *dl*-base is used, combine in pairs to form the two partially racemic compounds previously described. The whole of the *cis*-π-camphanic acid used in these and in previous experiments was collected and crystallised fractionally from alcohol; the first and last fractions crystallised in identical forms, namely, characteristic hexagonal plates (*Trans.*, 1896, **69**, 943), melted simultaneously, and had the same specific rotation in alcoholic solution.

176. "Resolution of *dl*-methylhydrindamine." By G. Tattersall.

In resolving *dl*-methylhydrindamine into its enantiomorphously related components by the use of *d*-bromocamphorsulphonic acid (*Trans.*, 1903, **83**, 918), the yield of salts of the *d*- and *l*-bases was always small, and the author, at Dr. Kipping's suggestion, attempted to find a more satisfactory process for the resolution of this *dl*-base.

Experiments then showed that *d*-tartaric acid, used so as to form the hydrogen tartrates of the base, effected an excellent separation of the *d*- and *l*-bases by crystallising the salt at the ordinary temperature. The most sparingly soluble fractions contained the hydrogen tartrate of the *d*-base. The purification of the bases was effected by converting the first fractions, containing chiefly the *d*-base (about one-third of the whole), and the last fractions separately into the *d*-bromocamphorsulphonates, and finally fractionating from water.

d-*Methylhydrindamine hydrogen tartrate*, $C_{10}H_{13}N,C_4H_6O_6,2H_2O$, crystallises from water in long, glassy prisms; it melts at 153—155°

with slight decomposition. In aqueous solution, it has a specific rotation $[\alpha]_D$ +33° and molecular rotation $[M]_D$ +99°.

l-*Methylhydrindamine hydrogen tartrate*, $C_{10}H_{13}N,C_4H_6O_6$, crystallises from water in aggregates of small, glassy prisms; it melts at 197° with slight decomposition. In aqueous solution, its specific rotation is $[\alpha]_D$ −5° and its molecular rotation $[M]_D$ −14·8°.

177. "Isomeric salts of *d*- and *l*-methylhydrindamines with *d*-chlorocamphorsulphonic acid." By G. Tattersall.

In a recent communication (Tattersall and Kipping, *Trans.*, 1903, 83, 918), the formation of isomeric salts by the combination of *d*- and *l*-methylhydrindamines with *d*-bromocamphorsulphonic acid has been described, and similar experiments have now been made with the same bases and *d*-chlorocamphorsulphonic acid.

The salt of each base was made from carefully purified material and subjected to prolonged fractional crystallisation; the end fractions were then examined. In the cases of both the *d*- and *l*-bases, the melting points of the successive fractions gradually fell from the first to the last fractions, this behaviour being also observed with the *d*-bromocamphorsulphonate.

The chlorocamphorsulphonates differ, however, from the bromocamphorsulphonates in their optical behaviour. With the former acid, the specific rotations of the last fractions are higher than those of the first fractions, whereas with the latter acid the opposite was the case. The statement is true for both aqueous and chloroform solutions.

The results obtained are summarised in the following table:

l-*Methylhydrindamine* d-*chlorocamphorsulphonate.*

		$[\alpha]_D$.	
	m. p.	In chloroform.	In water.
First fraction	239°	+3·3°	+34·2°
Last „	231—233°	8·0	35·8

d-*Methylhydrindamine* d-*chlorocamphorsulphonate.*

		$[\alpha]_D$.	
	m. p.	In chloroform.	In water.
First fraction	247°	+56°	+60°
Last „	225—230°	63	63

Both salts crystallise in anhydrous needles.

Similar results were obtained with hydrindamine *d*-chlorocamphorsulphonates (Kipping, *Trans.*, 1903, 83, 902), but in this case it was found impossible to isolate the isomeride of higher specific rotation.

178. "The four optically isomeric *l*-menthylamines and their salts." By F. Tutin and F. S. Kipping.

The principal object of this research was to ascertain whether *l*-menthylamine would give, with *d*-bromocamphorsulphonic acid, isomeric salts analogous to those obtained by combining this acid with the optically active hydrindamines (*Trans.*, 1903, 83, 873) and methylhydrindamines (*loc. cit.*, p. 918); for this purpose, it was first necessary to obtain the *l*-menthylamine free from optical isomerides. An examination of the menthylamine prepared by reducing the oxime of "*l*-menthone" showed that the crude basic product was a mixture of four optically isomeric active bases, and that the menthylamine obtained by heating "*l*-menthone" with ammonium formate was likewise composed of these four isomerides.

The explanation of these facts is afforded by a consideration of the optical configuration of *l*-menthone—a ketone which readily undergoes partial racemisation—and also of the reactions by means of which it is transformed into the base.

Since the four isomerides in question are derivatives of *l*-menthone (− −) and of *iso*-*l*-menthone (+ −), they are distinguished as *l*-menthylamine, neo-*l*-menthylamine, *iso*-*l*-menthylamine (*d*-menthylamine in the literature), and *iso*neo-*l*-menthylamine respectively.

l-Menthylamine combines with *d*-bromocamphorsulphonic acid giving a mixture of isomeric salts. One of these compounds can be obtained in a pure condition by repeated fractional crystallisation from water; it melts at about 226° and has a specific rotation $[\alpha]_D + 43{\cdot}7°$ in aqueous, and $[\alpha]_D + 48{\cdot}7°$ in chloroform solution. The isomeric salt cannot be obtained in a pure condition, but its presence is conclusively proved by the fact that the more readily soluble fractions melt at about 221° and have a specific rotation $[\alpha]_D + 38{\cdot}8°$ in aqueous, and $[\alpha]_D + 42{\cdot}8°$ in chloroform solution.

For the separation of the four isomeric *l*-menthylamines in the crude base, their hydrochlorides, *d*-bromocamphorsulphonates, and *d*-camphorsulphonates were fractionally crystallised, and also their formyl derivatives; *l*-menthylamine is thus isolated without difficulty, but for the separation of the other three isomerides, fractional crystallisation of their benzoyl derivatives was found to give the best results.

The following compounds are described :—

	l-Base.		neo-*l*-Base.		*iso*-*l*-Base.		*isoneo*-*l*-Base.	
	m. p.	$[\alpha]_D$.	m. p.	$[\alpha]_D$.	m. p.	$[\alpha]_D$.	m. p.	$[\alpha]_D$.
d-Bromocamphorsulphonate.	226°	+43·2°	70—75°?	—	166°	+65°	—	—
d-Camphorsulphonate.....	158	−5·3	188	+11·8°	177	+21·7	—	—
Benzoyl derivative	156	−61·9	128	−17·4	121	+22·7	104°	−3·8°

The specific rotations of the salts were determined in aqueous solutions, those of the benzoyl derivatives in chloroform.

179. "Preparation of the tetra-alkyl derivatives of stannimethane." By W. J. Pope and S. J. Peachey.

The preparation of the mixed tetra-alkylstannimethanes by the action of a zinc alkyl upon a trialkylstannimethyl iodide is difficult to carry out owing to the occurrence of secondary reactions, which greatly diminish the yield of the desired product. The authors have found that the magnesium alkyl iodides, bromides, and chlorides prepared by the method given by Grignard react vigorously with stannic chloride or with the mono-, di-, and tri-alkylstannimethane halogen derivatives, giving rise to the corresponding tetra-alkylstannimethanes. After treating the product with water, the tetra-alkyl derivative is readily separated in a state of purity by fractional distillation of the ethereal solution.

Tetraethylstannimethane, $SnEt_4$, is prepared by adding stannic chloride (1 mol.), dissolved in light petroleum, to the ethereal solution of magnesium ethyl bromide (4·5 mols.), washing with dilute acetic acid and distilling the ethereal solution; it boils at 180—181° under 758 mm. pressure.

Dimethyldiethylstannimethane, $SnMe_2Et_2$, may be prepared either by the action of magnesium methyl iodide on diethylstannimethylene chloride, bromide, or iodide, or by that of magnesium ethyl bromide on dimethylstannimethylene chloride, bromide, or iodide in ethereal solution. After treating with water and distilling the ethereal solution, the substance is obtained as a colourless liquid identical with that prepared by Frankland's method.

Trimethylethylstannimethane, $SnMe_3Et$, is obtained by treating trimethylstannimethyl bromide or iodide with the calculated quantity of magnesium ethyl bromide in ethereal solution, washing with dilute acetic acid, and fractionally distilling the ethereal solution; it boils at 107—108 under 758 mm. pressure.

Trimethylpropylstannimethane, $SnMe_3Pr^s$, is similarly prepared by the action of magnesium propyl bromide or iodide on trimethylstannimethyl bromide and forms a colourless liquid boiling at 129° under 764 mm. pressure. Triethylpropylstannimethane, $SnEt_2Pr^s$, from triethylstannimethyl bromide, boils at 195° under 764 mm. pressure.

Dimethylethylpropylstannimethane, $SnMe_2EtPr^s$, prepared by the action of propyl magnesium bromide or iodide on dimethylethylstannimethyl bromide, boils at 153° under 762 mm. pressure.

Methylethyldipropylstannimethane, $SnMeEtPr^s_2$, obtained from methylethylstannimethylene iodide and magnesium propyl bromide, is a colourless liquid boiling at 183—184° under 758 mm. pressure.

Tetraphenylstannimethane, $SnPh_4$, is conveniently prepared by the action of stannic chloride on magnesium phenyl bromide.

The further study of the mixed alkylstannimethanes, prepared by aid of the above reaction, is being continued, together with the examination of the action of the magnesium alkyl salts on silicon tetrachloride.

180. "Optically active esters of β-ketonic and β-aldehydic acids. Part IV. Condensation of aldehydes with menthyl acetoacetate." By A. C. O. Hann and A. Lapworth.

Menthyl acetoacetate condenses readily with aldehydes in presence of bases, and the following products have been obtained.

Dimenthyl ethylidenebisacetoacetate, $CHMe(CHAc{\cdot}CO_2{\cdot}C_{10}H_{19})_2$, produced when acetaldehyde is used, forms fine needles melting at 194—196° and has $[\alpha]_D - 24{\cdot}9°$ in benzene, a very slight mutarotation being noticed.

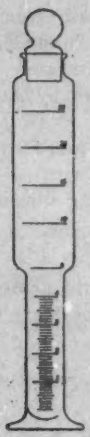
Menthyl n-*propylideneacetoacetate*, $CHEt{:}CAc{\cdot}CO_2{\cdot}C_{10}H_{19}$, is formed at the ordinary temperature, crystallises in glistening, elongated plates or needles, melts at 84—88°, and has $[\alpha]_D - 34{\cdot}9°$. It condenses with menthyl acetoacetate to form *dimenthyl* n-*propylidenebisacetoacetate*, $CHEt(CHAc{\cdot}CO_2{\cdot}C_{10}H_{19})_2$, which melts at 201—207° and has $[\alpha]_D - 26{\cdot}9°$.

Dimenthyl n-*butylidenebisacetoacetate*, $CHPr^n(CHAc{\cdot}CO_2{\cdot}C_{10}H_{19})_2$, melts at about 184° and has $[\alpha]_D - 16{\cdot}8°$. *Dimenthyl* isobutylidenebisacetoacetate, $CHPr^s(CHAc{\cdot}CO_2{\cdot}C_{10}H_{19})$, melts at 193—202°; in benzene solution, it has $[\alpha]_D - 42{\cdot}6°$, changing slowly to $[\alpha]_D - 46{\cdot}0°$.

Menthyl benzylideneacetoacetate, $CHPh{:}CAc{\cdot}CO_2{\cdot}C_{10}H_{19}$, crystallises in well-formed, glistening plates melting at 133—134°; in benzene solution, $[\alpha]_D - 10{\cdot}0$. With menthyl acetoacetate, it yields *menthyl benzylidenebisacetoacetate*, $CHPh(CHAc{\cdot}CO_2{\cdot}C_{10}H_{19})_2$, which melts at 203—206° and has $[\alpha]_D - 30{\cdot}4°$.

The formula usually ascribed to the monoalkylidene derivatives of β-ketonic esters does not readily account for the abnormally low values of their rotatory powers.

The statement that tertiary bases are not effective in bringing about the condensation of aldehydes with β-ketonic esters is incorrect; the very feeble tertiary bases, pyridine, quinoline, or dimethylaniline are useless, but trimethylamine and tripropylamine may be employed, although these are not so rapid in their action as the still more powerful secondary bases, such as diethylamine or piperidine.



181. "Estimation of the adulterant in citronella oil." By M. K. Bamber.

A mixture of 2 c.c. of pure cocoanut oil free from acid and 2 c.c. of the citronella oil under examination is shaken for one minute with 20 c.c. of 83 per cent. alcohol (sp. gr. 0·8273 at 30°) in the graduated tube (see Figure), this vessel being then rotated in a centrifugal machine for 0·5 to 1·0 minute. The volume of cocoanut oil, which now contains the impurity originally present in the citronella oil, is ascertained, and this reading minus 2 c.c. represents the adulterant. For example, 2·45 c.c. of residual oil represent 0·45 c.c. of impurity in the 2 c.c. of citronella oil or an adulteration of 22·5 per cent. A standard oil should be tested occasionally against the unknown samples in order to eliminate errors arising from the use of alcohol of different strengths.

In this way, the adulterant is separated and estimated in 3 or 4 minutes, the test being conducted at 29—30°.

ADDITIONS TO THE LIBRARY.

II. *By Purchase.*

Kohut, Adolph. Justus von Liebig. Sein Leben und Wirken. pp. 394. ill. Giessen 1904.

Posner, Theodor. Lehrbuch der synthetischen Methoden der organischen Chemie. pp. xxxii + 436. Leipzig 1903.

Schucht, Ludwig. Die Fabrikation des Superphosphats mit Berücksichtigung der anderen gebräuchlichen Düngemittel. Handbuch für den Düngerchemiker im Betriebe und im Laboratorium. 2 Aufl. pp. 336. ill. Braunschweig 1903.

Weber, Carl Otto. The chemistry of india-rubber, including the theory of vulcanisation. pp. xii + 314. ill. London 1902.

III. *Pamphlets.*

Cross, C. F., Bevan, E. J., Beadle, Clayton, and Sindall, R.W. C.B.S. Units and standard paper tests. An essay towards establishing a normal system of paper testing. pp. 25. London 1903.

Golding, John. A domesticated microbe. (*From the Proc. Nottingham Naturalist's Society*, 1903.)

London Essence Co. Half yearly report. Nos. 1 and 2. London 1903.

Rideal, Samuel, and Walker, T. Ainslie. Standardisation of disinfectants. (*From the Journal of the Sanitary Institute*, 24, 3.)

Schaer, Ed. Ueber die Verwendung des Chloralhydrates bei Drogen- und Nahrungsmittel-prüfungen, toxikologisch-chemischen Untersuchungen und technischen Expertisen. (*From the Berichte der Deutschen Pharmaceutischen Gesellschaft*, 1903, *Hft.* 6.)

Wells, Henry M. Cylinder oil and cylinder lubrication. Part I. (*From the Engineer, July* 17 and 31, *August* 7 and 14, 1903.)

At the next meeting, January 20th, 1904, at 5.30 p.m., the following papers will be communicated:—

"The chemical reactions of nickel carbonyl. Part I." By J. Dewar and H. O. Jones.

"The chemical reactions of nickel carbonyl. Part II. Reaction with aromatic hydrocarbons in presence of aluminium chloride. Synthesis of aldehydes and anthracene derivatives." By J. Dewar and H. O. Jones.

"Optically active asymmetric nitrogen compounds, *d*- and *l*-phenylmethylethylamine salts." By H. O. Jones.

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